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China Report

SCIENCE AND TECHNOLOGY

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22 AUGUST 1986

CHINA REPORT

SCIENCE AND TECHNOLOGY

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NATIONAL DEVELOPMENTS

PROSPECTS FOR 'SECOND NUCLEAR ERA' DISCUSSED

Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 7, No 1, Feb 86, pp 1-8

[Article by Lu Yingzhong [0712 2019 0022]: "The Second Nuclear Era and Prospects for Power Reactor Development"]

[Excerpts] Abstract: The decline of nuclear power in many developed and developing countries is analyzed and the reasons are traced back to their historical origins. The major weakness of current power reactor designs is identified, the negligence of inherent safety features leads to over-redundancy of systems which in turn resulted in huge cost over-runs and long lead time. Various advanced second generation power reactor designs are compared comprehensively, and the line of power reactor development in China is proposed.

III. China's Prospects for Power Reactor Development in the Second Nuclear Era

China's nuclear power industry is still in its infancy but the "first nuclear era" is drawing to an end on the international scene. As a result, the nuclear power suppliers from various countries are fighting to enter the Chinese market, thereby giving us the opportunity to select the mature and advanced technology and keep the purchase prices down. This is the good side for the rapid development of China's nuclear power. However, looking ahead, we should also realize the other side of the situation. In foreign countries the intrinsic weaknesses of the first generation nuclear power reactors have been realized and various attempts are being made to make fundamental changes to meet the higher challenges placed on the power reactor by the second nuclear era. There is, therefore, a tendency to anxiously get rid of the outdated technology. In the long term, the current PWR technology may be replaced by more advanced reactor technologies in the world market. If we do not catch up with scientific research and technological development, we may still be outdated at the end of the century even if we master the PWR technology.

In terms of China's actual needs, some of the characteristics of the second generation power reactors are particularly well-suited to the energy needs of China. Since primary energy source in China is coal and 70 percent of the coal is used for heating, the large cities and the industrial zones suffered severe environmental pollution. The long distance hauling of coal has also been a

burden for the transportation industry. Nuclear power for heating and nuclear electric power are therefore equally important in China's energy system. The nuclear reactors for heating purposes not only have different temperature parameters from a PWR power plant, they must also be located close to big cities and meet even higher safety requirements. Such features are only available on the second generation power reactors. Economically since the competitors of the nuclear stations are thermal power stations based on cheap coal and hydroelectric power stations built with cheap labor, the large, modern nuclear power stations are at a distinct disadvantage as it requires a hefty investment. Therefore, even though China has yet to enter the first era in nuclear power, proposals have been submitted to develop low temperature heating reactors for the cities, high temperature gas-cooled reactors, and medium and small scales nuclear stations to meet the objective needs. Some research and development ground work have been done for these types of reactors. It is logical and sensible to go from the microboiling natural circulation reactor for heating only to the double layer natural circulation heat-electricity hybrid boiling water reactor, or from the spherical bed high-temperature gas cooled reactor to the modularized spherical bed high-temperature gas cooled reactor. The development strategy of China's power reactors should therefore consist of two parts:

(1) Import advanced foreign technology for the large-scale pressurized-water reactor to build PWR stations which will serve as the backbone power plants of China's several major power grids in the tens of millions of kilowatt range and solve the electricity shortage in the eastern region. This is an important approach in nuclear power development.

(2) In the meantime, international cooperation should be developed on the basis of China's own technology. The nuclear reactor technology for heating purposes should be developed, followed by intrinsically safe heat-power dual purpose reactors, to solve the coal shortage and pollution problems in China's major cities and industrial zones. This should be regarded as another important approach in China's development of nuclear power. The latter is closely related to the development of the second nuclear era and advanced reactors abroad. Therefore, the long-term importance of this type of reactor is no less than that of the large-scale PWR nuclear station even though the new reactors are still in the testing and demonstration stage.

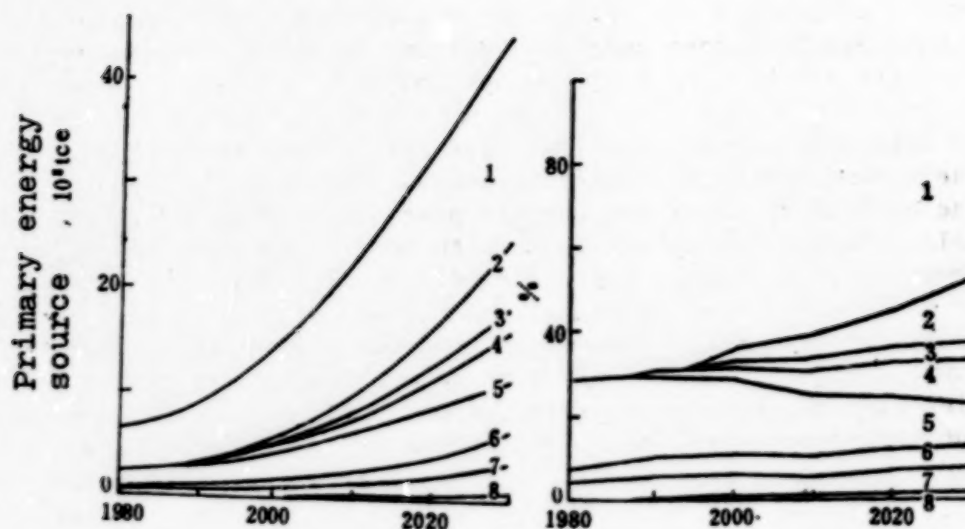


Figure 7. Long-term forecast for China's energy resources and the role of nuclear energy

Key:

1. Coal
2. Nuclear electric power and thermal electric power
3. Nuclear heating
4. Petroleum (unconventional resource)
5. Petroleum (conventional resource)
6. Natural gas
7. Hydroelectric power
8. Other regenerative energy resources

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NATIONAL DEVELOPMENTS

NATION'S ANTIBIOTIC, TETRACYCLINE HCl, ATTAINS FIRST-RATE STATUS

Shanghai JIEFANG RIBAO in Chinese 26 May 86 p 1

[Article by Zhu Peiren [4376 1014 0088], correspondent, and Gao Xiaoxiao [7559 5135 4562], reporter]

[Text] A tetracycline HCl product from China has been hailed as a first-rate antibiotic on the international market. Called "China Yellow" because of its characteristic yellow coloring, it has become a hot export item for China. Its scattered production in 16 different provinces and municipalities, and export through a multiple port set-up in the past has now been converted to a joint operation of consolidating exports through the port of Shanghai, which has led to a gradual rise in foreign exchange. At the recent Guangzhou Trade Fair the sale of "China Yellow" was negotiated at a favorable price, but supplies were not adequate to meet demand.

"China Yellow" is an export item marketed by the Shanghai Pharmaceutical Health Products Import and Export Corporation. Manufactured early on by the Shanghai Pharmaceutical No 3 Plant, it had broken into the international market in the early 1960's. Because of its high quality and unusual characteristics, it was highly rated by foreign businessmen. The general manager of the pharmaceutical section of one of the world's largest chemical companies had conducted a chemical analysis of "China Yellow" and concluded that its quality exceeded not only specifications set down in the BRITISH PHARMACOPEIA, but also that set by countries of eastern Europe.

In recent years, the pharmaceutical industry throughout China underwent new changes and development, and several scores of pharmaceutical plants were built to manufacture "China Yellow." But their scattered distribution through 16 export companies dispersed in Shanghai, Tianjin, Guangxi, Sichuan, Shenxi, etc., led to a competitive situation in promoting "China Yellow," with price wars and bid undercuttings. "When the sniper and the mussel fight each other, only the fisherman profits" could be used to describe this state of affairs. Because of competition between these export companies, the original favorable marketing climate for "China Yellow" was weakened, and a situation was created where this drain of "liquid riches" was directly affecting the accumulation of foreign exchange. According to statistics for the period 1978-83, the production volume of "China Yellow" continued to rise, but its export value continued to drop; the increased

foreign exchange that accumulated from an increased export volume was canceled out by a corresponding price drop in the commodity.

This critical situation caused the various export companies to explore a unified approach to export problems. In early 1984, the 16 import and export companies had a meeting in Beijing organized by the leadership of the parent corporation, and unanimously selected the Shanghai company as the export agent to consolidate all exports into a joint operation on the national level. Thus, a new approach was devised for a unified export policy known as multiple port commodity consolidation.

In this joint export venture, the role of the agent company is to centralize and regulate commodity supply, to consolidate export operations, and to determine the distribution and returns of foreign exchange on the basis of actual volume exported. Consequently, the multiple port companies have become cooperating partners, instead of competitors, in a joint enterprise. The local companies can concentrate their efforts in organizing and improving their supply network to assure timely product delivery. On the other hand, the agent company can concentrate on survey studies and timely information gathering to help complete transactions geared to the needs of the international market, at maximum returns on maximum export volume, which will effectively prevent this drain of "liquid riches." Since this joint export venture became operational, the accumulation of foreign exchange has been building up gradually. At present, the export value of "China Yellow" has seen a 10 percent increase over that before the joint venture was instigated and has turned around a 6-year price decline. [Editor's note: According to the 1985 Almanac of China's Foreign Economic Relations and Trade, China exported 680,929 kg tetracycline HCl valued at \$14,670,000 and 979,948 kg valued at \$17,860,000 in 1984 and 1983, respectively.]

When this joint export venture became a reality, the threat of a watered-down product that had surfaced momentarily was also controlled. Its underground source of supply was plugged, so that the export value of "China Yellow" would not be adversely affected. Since last year, product quality of "China Yellow" has been enhanced 10 percent.

Now that this consolidated approach to exports has been initiated, some foreign businessmen who are marketing "China Yellow" are doing very well. In the past, they had to deal with 16 multiple-port companies. Now, they need only to go through the Shanghai agent company: The trading channel is smooth, delivery date is guaranteed, product quality is assured, the price is reasonable, and business confidence is strengthened. At present, the sale of "China Yellow" on the international market is not only stabilized, it has also developed new markets in countries such as Great Britain, the Federal Republic of Germany, Switzerland, Belgium, Thailand, the United States, etc., and Hong Kong.

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NATIONAL DEVELOPMENTS

LIN ZIXIN DISCUSSES ROLE OF ZHONGGUO KEJI BAO

Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese No 1, Jan 86 pp 39-41

[Article by special reporter Jing Ke [5427 2688]: "The Situation in S&T Work and Our Mission; A Visit with Comrade Lin Zixin [2651 5261 2450], Secretary of the State Science and Technology Commission and Concurrent Director and Chief Editor of the China Scientific and Technological Information Society"]

[Text] A Brief Biography of Comrade Lin Zixin

He was born in April 1929 in Minhou County, Fujian Province. He graduated from Qinghua University in 1952 and was assigned to a technical post at the Beijing Broadcasting Equipment and Materials Plant. He was transferred in 1953 to the Culture and Education Commission of the State Council. Afterwards, he was engaged continuously in S&T management work and also became deputy chief editor of the Science Press, deputy director of the State Science and Technology Commission's Policy Research Office, president of the China Scientific and Technical Information Institute, and director of the State Science and Technology Commission's Scientific and Technical Information Bureau, and he worked routinely with the State Council's Technical Economics Research Center and in other capacities. He now serves as secretary of the State Science and Technology Commission and as concurrent director and chief editor of the ZHONGGUO KEJI BAO [CHINA S&T REPCRT] Agency.

Comrade Lin Zixin has participated in some of the work related to the formulation of the state's S&T development plans and S&T principles and policies. In recent years, he has been concerned with the question of the coordinated development of S&T, the economy, and society, and he has participated in research on "China in the Year 2000" and other topics.

In November 1985, just as we were writing a draft in Beijing concerning the situation in S&T work, we learned that Comrade Lin Zixin had been appointed concurrent director and chief editor of the China Scientific and Technological Information Society. We made a special visit to learn of his ideas regarding the management of ZHONGGUO KEJI BAO. Comrade Lin Zixin opened this topic by saying laughingly that the journal has many readers in the S&T world and that we would discuss his ideas concerning the situation and tasks in S&T work. We benefitted a great deal from our discussions.

S&T Ship Is Sailing in Channel of Service to Economic Construction

Comrade Lin Zixin said that it is the reforms in the S&T systems that are the precise reason that new vitality has been brought to S&T work, and they are truly revealing the important role and position of S&T in economic and social development. Do you remember when Comrade Zhao Ziyang, as representative of the CPC Central Committee and State Council, proposed in October 1982 that economic construction depend on scientific and technological progress and that S&T work be oriented toward economic construction? There was a lack of ideological unity among S&T circles at that time and many different viewpoints remained concerning certain important questions. The various shortcomings of the old system made it impossible for S&T work to become truly oriented toward economic construction, it was difficult for S&T achievements to be converted into forces of production, and the intellectual and creative abilities of S&T personnel were restricted. At the end of 1984, research was undertaken under the leadership of the CPC Central Committee on a draft document concerning reforms in the S&T systems. At the time, leading comrades in the CPC Central Committee repeatedly emphasized that the key to S&T reforms lay in sailing a correct course to turn around the enormous 10,000-ton freighter and move it into the channel of service to economic construction. The old saying is that a large ship is hard to turn around. Our S&T work operated for a long time under the old system and turning it into a new operational mechanism is not something easily done. A person of Chinese ancestry from the United States stated that "a firm grasp on orientation makes implementation easy and measures soft." Another reason for this statement is to arouse our concern for stability.

The "Resolution on Restructuring the S&T System" was announced more than 6 months ago and many achievements have been made. The most encouraging is that the enormous freighter is turning around smoothly and sailing into the channel of service to economic construction. Most S&T workers are striving to orient their own work toward society and toward markets and to serve the invigoration of the economy. Relationships have been established between 14 institutes under the Shanghai branch of the Chinese Academy of Sciences and more than 600 factories. They have extended 450 S&T achievements and obtained very good economic results. Technical markets were extremely active during 1985 and research institutes involved in technical development have earned a certain amount of income from technical transfers. More than 200 institutes across China have become self-supporting in their activities.

Comrade Lin Zixin said that ideas can only produce results through reforms, so S&T work naturally will be the concern of everyone. Leadership organs and leading comrades in many departments and local areas are treating S&T work as the order of the day now. From what I know, all provinces and municipalities have formulated several definite stipulations to achieve true implementation of the "Resolution" and guide reforms in S&T systems onto the path of healthy development. In addition, many provinces and municipalities are setting aside money from their local funds to assist S&T work. Henan and Hunan Provinces have set aside more than 10 million yuan. This is something unprecedented and extremely good.

Of course, reforms in S&T systems inevitably will encounter difficulties and many problems will appear. There is nothing unusual about this. For example, The "Resolution" proposes that the changes in the funding systems will require that most research organs involved in technical development should strive to achieve financial self-sufficiency within 3 to 5 years. Some comrades have raised the ante and favor doing things even faster. They have forgotten that financial self-sufficiency is not something determined by subjective desires. Coordination of S&T reforms and economic development means that the ability of a research institute to achieve economic independence requires a consideration of whether or not enterprises have the money to purchase the technical achievements of research institutes. The volume of exchange completed in technical markets also is restricted by the buying power of enterprises. Secondly, even if funding systems are reformed or technical markets are deregulated, the basic goal is to "shift orbits" in S&T work. We cannot be concerned only with hard numbers and forget the basic goals.

Many comrades among us are quite concerned with doing things right and easily become sick with worry. There are many experiences and lessons in this. Excessive worry slows our pace. It is possible that good things may be done poorly and things that were originally bad can be redeemed but they also may be so fouled up that they are impossible to straighten out.

Comrade Lin Zixin said that caution today can lead to calamity tomorrow and hard work can relieve our poverty. There can be no doubt that we are unwavering in our desire for reforms, but we must strive to be cautious and calm and avoid disturbances. China does not have the finances of a rich country, so hard work to build our nation is an important key element. S&T workers also should strive to "use money on the knife's edge" prudently.

Core of Our S&T Development Strategy Is To Promote Coordinated Development of S&T, the Economy, and Society

Comrade Lin Zixin continued by saying that considerations of efficacy during an examination of a project should be concerned with the situation, not only in terms of the need to study the present situation but also in terms of the need to look at development trends. The CPC Central Committee's opinion concerning the Seventh 5-year Plan proposed a strategic focus for S&T development. The S&T development strategy during the Seventh 5-year Plan also is of great significance. I feel that the core of our development strategy should be a requirement that science and technology make a contribution to the coordinated development of S&T, the economy, and society. I will only give my views concerning a number of the questions that this would involve.

Modern S&T are the most dynamic and decisive factors in the new forces of production. What is technology? The most recent definition from the U.S. National Academy of Sciences is that "technology deals with the special needs of the economy or society and is an easily destroyed resource used to control

all factors of production and the products produced (including shipping, storage, and repair) and composed of the relevant knowledge, technical abilities, and means for the provision of these services." This definition points out technology's goal-oriented nature and applicability, which are its two main characteristics.

There is a saying in foreign countries: "Technology is the answer, but what is the question?" This shows everyone the enormous force of technology and its ability to solve many problems, but you first of all must be clear as to what the problems are that actually must be solved. The reason is that are differences between science and technology in their application. The principle of science is "universal applicability," so it is used in a universal manner. Technology, on the other hand, must be closely matched with specific economic and social conditions before it can produce the best results. The world's experience in technical transfers since World War II shows that not all technologies that are useable in the developed nations are of use to developing nations. The World Bank pointed out in a recent investigation report on the Chinese economy that China has continually adopted a large number of "inconspicuous" technologies and placed greater importance on them than on the adoption of extremely advanced technologies. Reducing the differential between an advanced factory and a backward one in the same industry has been more important than building a small number of the most advanced factories. This statement illustrates the necessity of technical selection and evaluation. When we are selecting a technology, we cannot simply note which is the most advanced but instead should be concerned with its economic rationality and social applicability.

To convert technical achievements into forces of production as quickly as possible, the State Science and Technology Commission has formulated a "spark plan" for relying on S&T to invigorate medium-size and small enterprises. It emphasizes that strong attention in the short term must be given to reliance on S&T to invigorate the rural economy and promote healthy development in town and township enterprises. In a memorandum concerning the "spark plan" of the State Science and Technology Commission, Comrade Zhao Ziyang pointed out that integration of rural enterprises with S&T should be observed as a basic principle for a long time to come, and that it inevitably will have unexpected results. Town and township enterprises are small enterprises, and they have grown to more than 6 million in number. Moreover, many urban enterprises are small enterprises. Many nations have shown a great concern for the role of small enterprises in economic development. I recently visited Seoul, South Korea, to participate in a conference of specialists organized by the United Nations that held special discussions concerning developmental strategies and policy questions related to small enterprises. The conference felt that the developing nations often have a tendency to be concerned only with large enterprises and neglect the small ones. Small enterprises, however, play eight important roles: 1) they can create more employment opportunities for labor, so the development of small enterprises will be a basic route for the absorption of a surplus labor force or of one that is growing too rapidly. 2) They can promote the development of rural areas, avoid excessive growth of cities, and prevent an expansion of rural-urban differentials. 3) They strengthen the

links between industry and agriculture and facilitate the utilization of local raw material resources and a smaller amount of waste material. 4) Basic structural investments are rather low. 5) Small enterprises provide fertile ground for training entrepreneurs. 6) Individual entrepreneurs are useful as important sources of individual accumulation and can encourage other individuals to accumulate for productive purposes. 7) They have the characteristics of flexibility in production and product diversity and easily adapt to changing market demand. 8) Their specialized skills and excellent costs make small enterprises important producers of certain small parts for large enterprises. This conference also proposed that small enterprises be assisted in solving problems like low technical standards, poor-quality products, a lack of close integration with large enterprises, a shortage of effective government assistance, and so on.

Science and Technology Are Bedrock for Construction of Socialist Spiritual Civilization

During the Seventh 5-year Plan, considerable emphasis has been placed on the technical transformation of traditional industries. I feel that technical transformation and improvements in technical management to raise the quality of products and services are urgent tasks at the present time. Of course, improvement of product quality concerns people's attitudes toward work. The poor quality of many products and services is not primarily a technical problem. It is instead a problem of attitudes toward work and a willingness to labor. This is an ideological question as well as a question of the construction of spiritual civilization. We can see that the construction of material civilization also involves the construction of spiritual civilization and that the two are inseparable.

Comrade Yaobang stressed that the "construction of a highly developed material civilization is an indispensable foundation for the construction of socialist spiritual civilization, and the construction of socialist spiritual civilization not only plays a major role in the construction of material civilization but also guarantees that it will have a correct developmental orientation." We certainly must combine the construction of material civilization with the construction of socialist spiritual civilization.

Many foreign scholars frequently decry the high level of development of material production and the serious decline in spiritual civilization in capitalist countries. After discussing progress in the United States over the previous century at an academic conference to celebrate the centennial of Edison's discovery of the light bulb, the former president of the U.S. National Academy of Sciences [Handler] stated that when examining certain indices of progress in social structures, the situation in the United States did not look so good. He used numbers to illustrate family instability, a rising crime rate, and the fact that unemployment had become a very serious problem in the United States. We must not allow this sort of abnormal situation to develop.

The decision of the CPC Central Committee concerning reforms in S&T systems pointed out that science and technology increasingly are becoming the bedrock on which a modernized spiritual civilization is built. We have a superior socialist system, which is an important foundation for the utilization of S&T, since it can permit S&T to play an enormous role in construction of socialist spiritual civilization. We must use scientific Marxist theories and communist ideology, historical materialism and dialectical materialism, and the achievements of modern science and technology to enlighten the people and to guide their lives, production, and all types of scientific experiment activities. In summary, the use of the scientific spirit to transform China is a major task we now face.

Historical Mission of ZHONGGUO KEJI BAO

Comrade Lin Zixin said that given this situation, the State Council decided to establish ZHONGGUO KEJI BAO. It can be stated that ZHONGGUO KEJI BAO was born of the necessity to adapt to the age. As a mouthpiece for the party and government in the realm of science, it will serve as a link and bridge between S&T workers and the masses, so ZHONGGUO KEJI BAO has undertaken an important historical mission.

Long-term exploration and practice are essential to accomplish this historical mission. The question of where to start is a very serious one for us. For one thing, this is the first national science and technology journal, so it has no model at present.

Modern S&T increasingly permeate the realms of material life and spiritual life in society. It is also hoped that ZHONGGUO KEJI BAO will be able to expand gradually into all of society and serve an even broader audience. The main targets envisaged at present are the large number of S&T workers and leading cadres in the party, government, military, and enterprises; economic and S&T management cadres, teachers and students in institutions of higher education; S&T hobbyists in cities and towns; middle and lower school teachers; and people in economic circles, academic circles, and other areas. Meeting the needs of different readers means that the work will be quite difficult.

What requirements do our readers place on ZHONGGUO KEJI BAO? A preliminary understanding indicates that they can be divided into the following eight points:

1. It should provide timely and comprehensive reporting of the news about major advances in science and technology in China and abroad. We not only will introduce international advances to a domestic audience but will also introduce Chinese achievements to those outside China. ZHONGGUO KEJI BAO should have an international quality and strive to be a compendium of S&T news. This sort of news can enlighten Chinese readers and it also can continually expand and update our knowledge.
2. It should announce and describe party and government principles and policies concerning S&T development as well as the instruction and opinions of leading

comrades. This will aid in having a clear work orientation and provide guidance for our actions.

3. It should introduce knowledge in the natural and social sciences and provide both the newest knowledge as well as the necessary basic knowledge. Economic and management knowledge will be introduced to those involved in the natural sciences and S&T knowledge will be introduced to those involved in economics. To facilitate its accumulation, something like an information and news bank should be established.

4. It should express views, publish opinions, organize some discussions, report on various scholarly activities, enliven ideas, and draw on the collective wisdom of the masses. We should adhere to the "100 flowers" principle of free discussion in this area and create an environment for free academic discussion.

5. It should report on and introduce people in all areas, including those who have made outstanding contributions as well as those who work behind the scenes to provide service-type work, so that people can draw strength and gain encouragement from them.

6. It should use a limited number of words to convey a greater amount of news. Articles should be short and the various news items should be sifted through. Papers should have their own particular viewpoints and not be the same as other papers. Political news can be summarized in brief reports.

7. Professional advisory services should be provided. It should answer readers' questions, provide relevant information to the readers, and so on.

8. It should strive to attract readers in all areas and publish more things concerning S&T and the economy, S&T and education, S&T and military affairs, S&T and life, and other topics.

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CSO: 4008/2071

NATIONAL DEVELOPMENTS

BRIEFS

INTERNATIONAL ACADEMIC EXCHANGE--Beijing, 9 Jul (XINHUA)--International academic exchanges have enlivened teaching and scientific research in more than 20 universities and colleges in Beijing, PEOPLE'S DAILY reports today. These universities and colleges are in contact with more than 100 universities in over 20 countries. They have sent thousands of graduate students and lecturers to study abroad, and sent more than 3,000 lecturers to give lectures, participate in academic conferences or make academic inspection tours since 1978. Altogether 4,000 foreign lecturers have been invited to give lectures for short periods, and 8,000 foreign lecturers and researchers have attended international conferences and made inspections and visits in China. A total of 300 foreign lecturers and 2,100 foreign students are in 15 universities and colleges here. Such academic exchanges have enabled universities and colleges to learn from each other's strong points, the paper noted. Guo Pingzhong, associate professor in the department of biology at Beijing Teachers' College, opened the first course in the country--population genetics--soon after returning from study abroad. Beijing Engineering Institute has set up specialities in bioengineering and robots in accordance with suggestions from lecturers who studied in the United States and Japan. [Text] [Beijing XINHUA in English 0647 GMT 9 Jul 86] /9604

FUNDS FOR YOUNG SCIENTISTS--Beijing, 30 Jul (XINHUA)--The Chinese Academy of Sciences will provide 3.5 million yuan (about U.S.\$940,000), 1.5 million yuan more than last year, for young scientists, according to today's CHINA SCIENCE AND TECHNOLOGY REVIEW. The paper quoted an academy official as saying that the money will be given to 150 scientists studying such subjects as mathematics, mechanics, physics, chemistry, biology, materials, environment and management. The science fund established last year is aimed at encouraging young scientists to engage in the research of basic sciences and foundation studies for applied sciences. Starting this year, those under the age of 35 can apply for the money although research groups and young scientists working in remote areas have priority. Scientists engaged in different subjects and working in different units are encouraged to cooperate among themselves and with foreign colleagues, the official said. [Text] [Beijing XINHUA in English 0627 GMT 30 Jul 86] /9604

SHANGHAI UNIVERSITIES REAP REWARDS--Shanghai, 19 Jul (XINHUA)--Universities and colleges in Shanghai won 116 prizes for promoting scientific and technological progress in 1985, accounting for 23.8 percent of the total awards given by the municipal government. The municipal government recently gave awards to 488 scientific achievements made last year. Local universities and colleges, with one third of the city's senior scientists and scholars, now play an important role in Shanghai's economic construction and social development, said municipal officials. By cooperating with enterprises, they tackle key problems in production and help apply scientific achievements to production. Among the rewarded achievements are 10 papers on general topics involving economic and social development. These include "Shanghai's Short-Term Energy Economic Model," "Overall Socio-Economic Model in Xinjiang Uygur Autonomous Region" and "Index and Methods to Assess Scientific Achievements" by Shanghai Jiaotong University. "China's Economic Development Model and Its Development Strategy" by Fudan University, an analysis of the relations among production, distribution, prices, finance, population, employment and balance of international payments, has been included in the massive State Council research project, called "China by the year 2000." [Text] [Beijing XINHUA in English 0731 GMT 19 Jul 86] /9604

CSO: 4010/2018

PHYSICAL SCIENCES

CURRENT PATH OF KUROSHIO EAST OF TAIWAN STUDIED

Beijing HAIYANG YU HUZAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese Vol 16
No 4, Jul 85 pp 253-260

[Article by Guan Bingxian [4619 4426 6343], Oceanography Institute, Chinese Academy of Sciences: "The Deep Water Current Path of the Kuroshio East of Taiwan"*]

[Text] Abstract: Based on the deep-water observation data gathered by the Japanese research vessel "Komahashi" during February and March of 1940, the deep-water current path of the Kuroshio east of Taiwan was studied by temperature distribution and dynamic height topography. The results show that there existed a cyclonic eddy in the region east of Lanyu Island with a size of about 100 x 200 km. From 200 m down, the Kuroshio path heading north along the southeast coast of Taiwan started to meander cyclonically around the cold eddy, the extent of which increased with increasing depth, and the mainstream was no longer heading straight north. Rather, it gradually turned toward east-southeast. This was mainly due to the blocking effect of the existing submarine ridge northeast of Taiwan on the deep-water current flowing north. The appearance of the meandering and cold eddy in the Kuroshio east of Taiwan, though smaller in scale and weaker in strength, occurred during the same period (1934-1944) that large meandering and cold water mass appeared in the Kuroshio south of Japan. It is worth investigating to see if there exists certain intrinsic correlation between the two events.

By far, little research has been done with respect to the path of the Kuroshio east of Taiwan, particularly that of deep-water current. Zhu Zuyou [2612 4371 0147]^[2] studied the path of the Kuroshio and its changes by analyzing the hydrological survey data from the research vessel (R/V) "Yangming" and the GEK observation data from the R/V "Jiulian" gathered during the Cooperative Study of the Kuroshio and Adjacent Regions (CSK). He pointed out that the path of the Kuroshio east of Taiwan had wave characteristics and its flow axis shifted. He also believed that the changes of the Kuroshio here were dictated by the following factors: 1) the initial condition of the current originated from the Philippine Sea;

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Received: 2 December 1983.

2) planetary vorticity; 3) sea floor terrain; 4) the large-scale changes of the Pacific atmospheric and ocean circulations. He further pointed out that the sea floor here is highly irregular due to the presence of Lanyu Island and others. Therefore, eddies often occur. The author^[1] has studied the impact of sea floor terrains of Taiwan and adjacent areas on the path of the Kuroshio through recorded hydrological information in history and stressed that because the depth of the peaks of submarine ridges northeast of Taiwan is far smaller than the water mass thickness of the Kuroshio, the water was squeezed when flowing past them and its flow axis was deflected to the right. Fan Guanglong [5400 0342 7893]^[3] has pointed out in his study of the ascending currents along the southeast coast of Taiwan that cyclonic deflection of the flow axis of the Kuroshio occurred when it passed through the shallow submarine ridges near Ludao Island, which caused the ascending currents. He has also pointed out, based on the phenomenon that the slope of the isotherms at 200 m or deeper is the opposite of that at the surface, the possible existence of a countercurrent in the deep waters within the immediate vicinity of the coast that is opposite to the northbound surface flow.

However, these researchers have not really addressed the path of deep-water current and its changes, particularly the impact of topographic features (including Lanyu and other islands nearby as well as the submarine ridges northeast of Taiwan) on the deep-water current path of the Kuroshio. In this article, it is attempted, as a case study, to use the 40-year-old hydrological data to explain the deep-water current path of the Kuroshio east of Taiwan and the impact of the topographical features.

1. Data

From 26 February to 2 March 1940, the Japanese R/V "Komahashi" carried out hydrological survey of the waters south and east of Taiwan. The locations of the observation sites are shown in Figure 1^[6]. Except for one shallower site south of Gialanpi, the survey covered a depth of 1,200 m at all sites and provided better information for the study of the path of the Kuroshio, particularly that of the deep-water current.

The temperature distributions at 200, 500, 700 and 1,000 m are shown in Figure 2. The temperature distributions of three near-zonal profiles off the southeast coast of Taiwan are shown in Figure 3. It can be seen from Figures 2 and 3 that, for a depth of 500 m or less, temperature increases with increasing distance from the coast but, from a depth of 600-700 m down to 1,200 m, there appears a cold region east of Lanyu. In the waters off the southeast coast of Taiwan, the trend of temperature distributions at 1,000 m is the reverse of that near the surface. With the exception of the eastern boundary of the cold region, temperature decreases with increasing distance from the coast. Of course the temperature gradient is very small. This kind of distribution feature indicates that there was a cold region east of Lanyu that spread wider toward north with increasing depth, which might have significant impact on the deep-water current path of the Kuroshio.

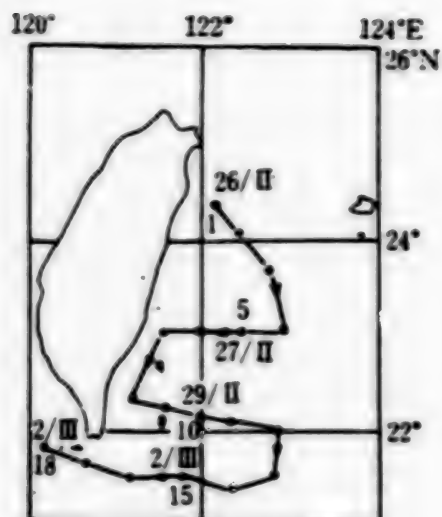


Figure 1. The Locations of Observation Sites (R/V Komahashi, 2/26-3/2 1940, from JODC, 1970b)

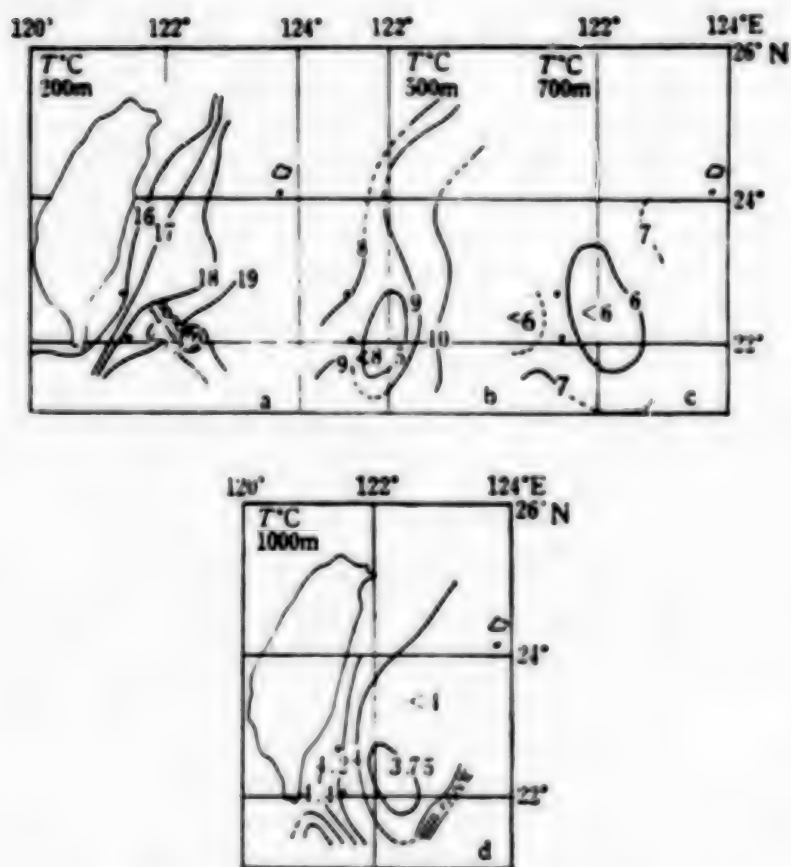


Figure 2. The Temperature (°C) Distributions at Each Layer

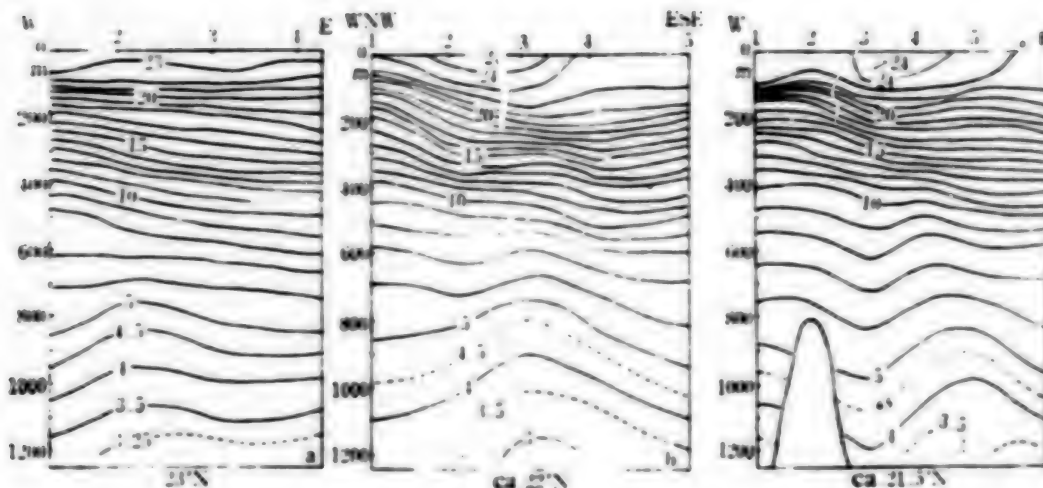


Figure 3. The Temperature Distributions ($^{\circ}\text{C}$) on the Near-Zonal Profiles

II. Flow Pattern of Land-Deflected Flow

The dynamic height distributions for each layer (0, 200, 400, 500, 700, 800 and 1,000 db) are shown in Figure 4, using 1,200 db as zero-surface.

From the land-deflected flow patterns shown in Figure 4, it can be seen that there is a cyclonic eddy at each layer near the region east of Lanyu that corresponds to the cold region in the temperature distribution chart. The Kuroshio coming from south of Taiwan flowed past the east and west sides of the eddy and continued northward. At the surface (Figure 4a) it mainly passed the west side of the eddy toward East China Sea. Only a small portion meandered past the east side toward north. The maximum flow appeared west of Lanyu and reached 103 cm/s. At the 200 m layer (Figure 4b) the path of the Kuroshio began to change. The flow along the west side of the eddy toward north weakened. The Kuroshio south of Lanyu initially appeared anticyclonic, then the trend toward cyclonic flow along the east side of the eddy to the north became increasingly obvious. But the maximum flow was still to the west of Lanyu and reached 49.5 cm/s. The second fastest flow was to the east of the eddy and reached 42.6 cm/s. The path at 400-500 m was basically the same as at 200 m except that the maximum northbound flow was no longer to the west of Lanyu but shifted to the east of Lanyu on the east flank of the eddy and could reach 32 cm/s at 400 m. In the meantime, the size of the eddy also increased, especially along the north-south direction at 122°E . The edge of the eddy reached 23.5°N to the north and 21.5°N to the south. The long axis was over 200 km (Figures 4c, d). At 700-800 m, the eddy further extended toward east and its southeast portion reached 123°E . At the same time, the flow that moved north along the west side of the eddy toward East China Sea decreased further. A major proportion of the mainstream of the Kuroshio coming from the southeastern waters of Taiwan first flowed anticyclonically south of Lanyu and then meandered past the southern part of the eddy and flowed cyclonically (Figures 4e, f). At 800 m, the northbound water all flowed toward east and southeast due to the blockage of the submarine ridges east of So-uh. On the other hand, at locations

farther away from the southwest coast of So-uh there were weak (about 6-8 cm/s) northeastern flows. This might be the evidence of the existence of a northbound current coasting along the southeast shores of Taiwan. At 800 m, the maximum northbound flow appeared at the east side of the eddy and reached 10.2 cm/s. At 1,000 m, the flow pattern was almost identical with that at 800 m, only the flow was slower and the maximum northbound flow along the east side of the eddy was reduced to 4.3-4.5 cm/s (Figure 4g).

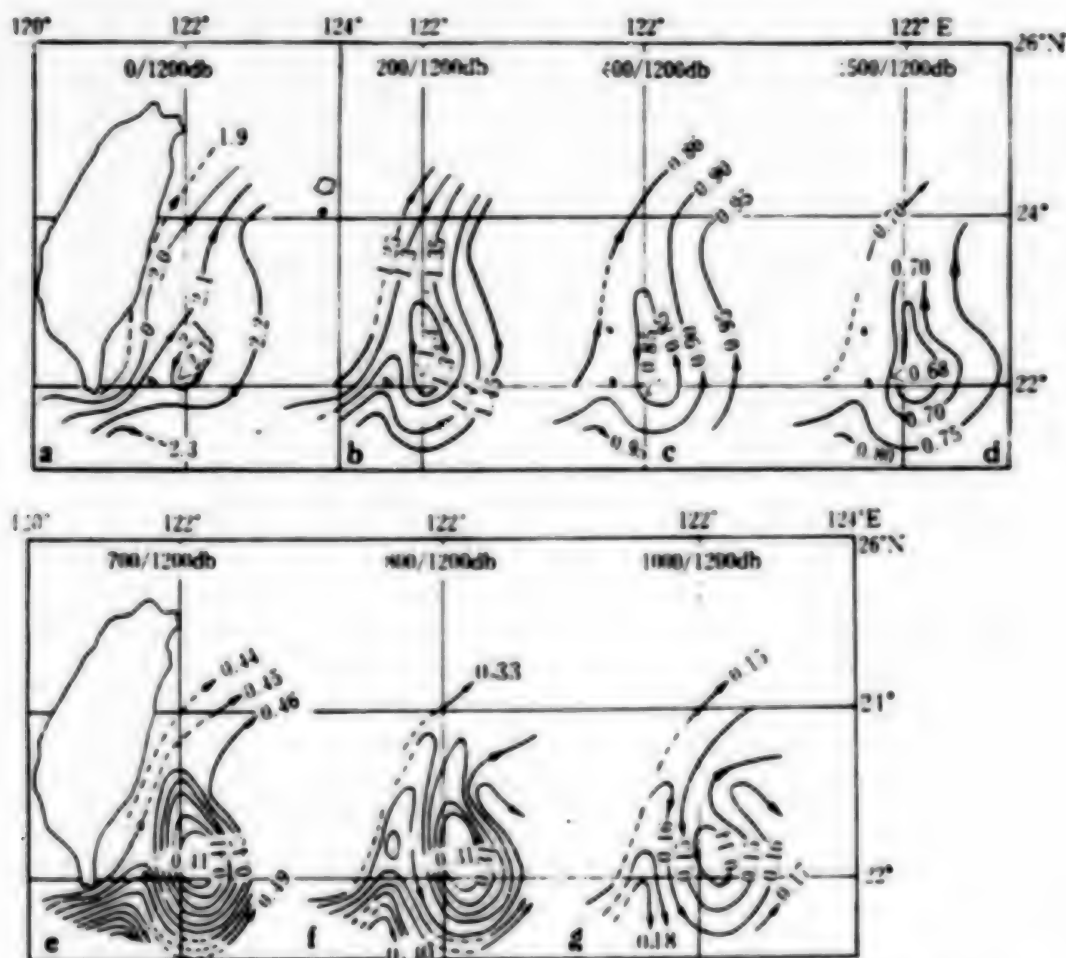


Figure 4. The Dynamic Height (dyne·m) Distributions at Each Layer

It can be seen from the above descriptions that, starting at approximately 200 m, the path of the Kuroshio moving north along the southeast coast of Taiwan increasingly meandered around the cold eddy and the mainstream no longer flowed straight north but turned from NE to SE-E-N. At 800-1,000 m, it flowed toward east predominantly near 23°N. On the north side of the meandering path appeared a cyclonic eddy about 100 x 200 km in size, which corresponds to the ascending of cold water in the vertical temperature profile (Figure 3).

It can also be seen from the land-deflected flow patterns described above that there are distinct differences between the flow patterns of upper and lower layers. It can be seen from the temperature profiles (Figures 3a-c) that there are noticeable differences in the slanting directions of the isotherms at upper and lower layers, roughly divided by the 600 m layer. Based on this phenomenon, the average flow speed of upper (0-600 m) and lower (600-1,200 m) layers were calculated and shown in Figures 5a and 5b. The arrows in the chart denote the magnitude and direction of the component, normal to the profile, of the average flow rate between two sites. The lines denote the flow patterns drawn based on these vectors. It can be clearly seen from these charts that the flow pattern of upper layer consists mainly of northbound flows toward East China Sea whereas that of lower layer mainly of eastbound flows meandering around the eddy toward the Pacific, although they both have a cyclonic eddy.

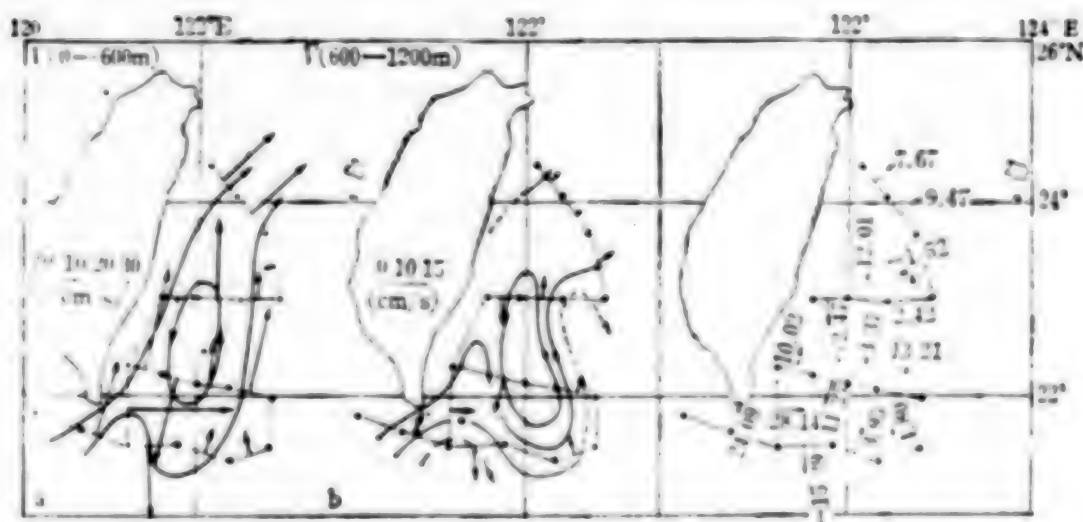


Figure 5. Distributions of the Upper and Lower Layer Land-Deflected Flow Rates (cm/s)

Figure 6. Flux Between Two Sites (1,200 db as zero-surface)

The flux between two sites (volume transport), using 1,200 db as zero-surface, are shown in Figure 6. Positive value means northbound and negative value southbound. It can be seen from the chart that, at the southern tip of Taiwan, the total flux of the Kuroshio flowing toward the east coast of Taiwan was about 24 sv¹⁾. The flow that passed through northwestern waters of Taiwan toward East China Sea was about 17 sv. The former flux value is probably too high because a small portion of them flowed into the Taiwan Strait. Also the waters south of Gialanpi are only 600-700 m deep. The impact of this was not eliminated in the calculations. The latter value probably is too low because the site farthest north is a bit too far from the coast. Limited by the available observation data, it is difficult to consider these factors in a more precise manner. Therefore, as a rough estimate, about 5-6 sv, i.e. about 25 percent of the Kuroshio water, flowed east toward the Pacific.

1) 1 sv = $10^6 \text{ m}^3/\text{s}$

III. Discussions

1. The emergence of meandering and cold water mass of the Kuroshio in the waters south of Honshu, Japan has become one of the most actively studied subjects in the current field of western boundary fluid mechanics. Especially in light of the recent discovery of its long-range correlation^[10] with the El Nino on the equator off the west coast of South America, the study of the mechanism of the appearance of meandering and cold water mass has drawn the attention of the scholars in oceanography and meteorology.

Within the main body of the Kuroshio between the waters off southeast coast of Taiwan and Choshi, Honshu, except that meandering and cold water mass appeared several times near southern Honshu, no noticeable meandering and cold water mass have ever been observed so far in the East China Sea and off the east coast of Taiwan. Therefore, according to existing literatures, there is no prior report regarding the appearance of meandering and cold water mass in the Kuroshio from surface to deep layers east of Taiwan as described in this article. Attention should be paid to the fact that the time the meandering and cold water mass appeared in the waters east of Taiwan (February-March 1940) falls within the period (1934-1944) that great meandering and cold water mass first appeared in the Kuroshio south of Japan (which can be confirmed by available data). Whether there exists certain intrinsic correlation between the two events is worth studying. Unfortunately, there is no other information to support that events similar to that described in this article (February-March 1940) also occurred east of Taiwan during other periods (e.g. 1953-1955, 1959-1963 and 1975-1980) in which large meandering and cold water mass appeared in the Kuroshio south of Honshu. Naturally, the size and strength of the meandering and cold water mass at the two locations are different. The dimension (longitudinal and latitudinal) of the cold water mass south of Honshu is about $(3-4)^{\circ} \times 2^{\circ}$ while that east of Taiwan is only $2^{\circ} \times 1^{\circ}$. Also, the horizontal temperature gradient of the latter is much weaker than that of the former. Furthermore, the former occurred in the deep ocean west of the underwater ranges of Izu far away from any island while the latter appeared in the deep waters east of Lanyu and Ludao. It is not known whether their appearances have certain cause-and-effect relationship with the topographical features of islands. But no similar phenomenon is found when the research data of other periods (especially those of the R/V "Yangming" during CSK) are examined. Figure 7a shows the temperature distribution at 1,000 m during September 1967 as observed from the R/V "Yangming"^[5]. It is quite different from the distribution at 1,000 m during February-March 1940 (Figure 2d) and there is no sign to suggest the existence of anything similar to a cold eddy. Figure 7b shows the corresponding land-deflected flow pattern at 800 m (1,000 db as zero-surface). It is quite different from the pattern in Figure 4f. Therefore, their appearances may have nothing to do with the topographic features of islands.

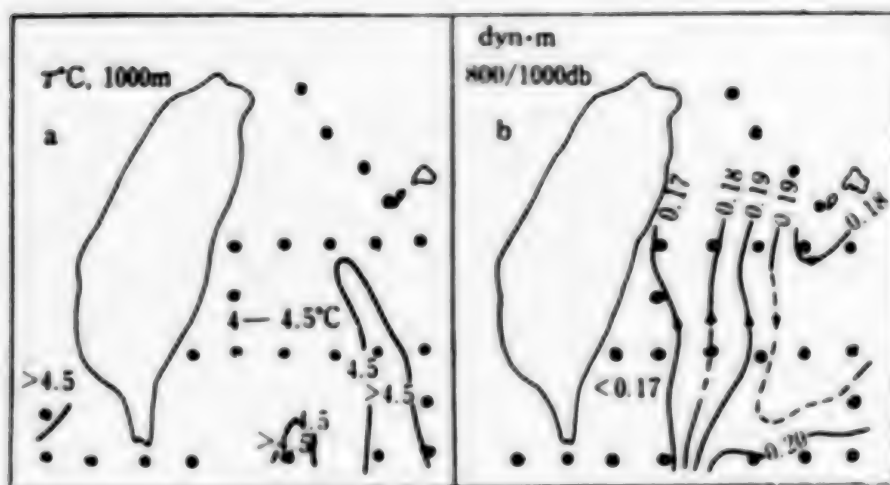


Figure 7. Temperature ($^{\circ}\text{C}$, 1,000 m layer) and Land-Deflected Flow (dyne-m, 800/1,000 db) Distributions Observed by R/V "Yangming" During September 1967
(From Data Report of CSK, No 135, JODC, 1970a)

2. The submarine ridges east of So-uh extend in a direction nearly perpendicular to the coast (ESE) and the depth reduces drastically from 1,000-2,000 m at north and south sides to around 500 m, the shallowest point being less than 200 m. Therefore, even the water mass of the Kuroshio at the depth of 500-600 m or less can squeeze through the submarine ridges and flow toward East China Sea, it is quite certain that a substantial portion of them cannot pass through because of the blockage by the submarine ridge wall and have to return south. This in turn will block the deep-layer water that continues moving north from the southeastern waters of Taiwan and force the northbound water meandering around the east side of the cold eddy to turn E-ESE and flow toward the Pacific.

So far there is no comprehensive, detailed study of the current in the waters east of Taiwan and south of Ryukyu Islands except some scattered reports. For example, in his study of the Kuroshio flux at East China Sea and southeast of Yaku Jima, Nitani^[8] also presented the multi-year variation curve of the flux of NE flow in the waters southeast of Ryukyu Islands. In their discussion of the phenomenon of subtropical gyre splitting in northwest Pacific region, Hasunuma and Yoshida^[4] reported the land-deflected flow pattern (0/1,000 db) chart of this region and a series of belt-shape flow systems including subtropical countercurrents. In his discussion of the reciprocal relationship between the Kuroshio flux at PN and E profiles, Kawabe^[7] pointed out that, when meandering occurred in the Kuroshio south of Japan, it was likely a northbound deep-water current equivalent to the deep western boundary current would develop east of the submarine ridges of the Ryukyu Islands, which would retard the "apparent" land-deflected flow flux through the upper layer of the E profile. In their discussion of the fact that the land-deflected flow flux through PN profile is less than that through I profile (southeast of Kyushu), Nishizawa et al.^[9] pointed out it was possible that there existed a NE-bound current.

It can be seen from above reports that there exists an eastbound current in the waters southeast of Ryukyu Islands and it is possible that a deep-water western boundary current exists.

It can be speculated that the portion of the deep layer water of the Kuroshio meandered toward north along the east side of the cold eddy but was forced to turn eastbound due to the blockage by the submarine ridges east of So-uh, as described earlier in this article, might become the recirculation of the deep-water current of the Kuroshio and flow south. And it is also a possibility that it is associated with the deep-water western boundary current southeast of Ryukyu Islands as surmised by Kawabe[7] or it is the upstream portion of the deep-water western boundary current. In order to examine these speculations, it is necessary to carry out further deep-water observations in the waters east of Taiwan and south of Ryukyu Islands.

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PHYSICAL SCIENCES

MATHEMATICAL MODELS OF WIND, DIVERGENCE FIELDS OF TYPHOON PROPOSED

Beijing NANHAI HAIYANG KEXUE JIKAN [NANHAI STUDIA MARINA SINICA] in Chinese
No 3, Jul 82 pp 81-90

[Article by Yuan Shuyao [5913 0647 1031] and Xu Jiajun [1776 1367 7165],
Nanhai Oceanography Institute, Chinese Academy of Sciences; paper received
18 September 1979]

[Text] The catastrophes brought about by the destructive waves caused by the torrential rains and gusty winds of a typhoon are all too familiar to the meteorologists. Under the current situation of lacking direct observation data at the sea level, understanding the wind field structure of typhoon will have significant implications in the forecast of strong wind and waves as well as the further study of the weather patterns of typhoon. Such are the objectives of this article, in which preliminary studies of the problems associated with the distribution of wind and divergence fields were carried out and the mathematical models of typhoon wind and divergence fields at the sea level were established.

I. Model of Typhoon Wind Field at the Sea Level

The low altitude wind field of typhoon can be divided into three distinct regions.

- (1) Strong wind region: between the periphery and the maximum speed region of a typhoon, where wind speed increases toward the center.
- (2) Maximum speed region: a belt surrounding the eye with largest wind speed where strong convections and heavy precipitations occur.
- (3) The eye: the inner core of a typhoon where wind speed decreases toward the center.

When stalled, the wind field of a typhoon has been observed to be near circular. The horizontal movement of the strong wind region can be approximately described by a gradient wind equation:

$$fV_r + \frac{V_\theta^2}{R} = \frac{1}{\rho} \frac{\partial P}{\partial R} \quad (1)$$

The solution to equation (1) is as follows:

$$V_{gr} = -QR \sin \varphi + \sqrt{(QR \sin \varphi)^2 + \frac{R}{\rho} \frac{\partial P}{\partial R}} \quad (2)$$

where V_{gr} is the velocity of gradient wind; Q the angular velocity of earth's rotation; R the distance between the locations with atmospheric pressure P and the center of a typhoon; φ the altitudes of the locations with atmospheric pressure P , which are often replaced by the altitude of the center of a typhoon; ρ the air density at the sea level.

Equation (2) is for the gradient wind of a stalling typhoon without considering the effect of friction with sea surface. Many investigators have used this equation to obtain the distribution of typhoon wind field.

Typhoon causes strong waves at sea surface which greatly increases the roughness of the surface. To establish correctly a mathematical model of typhoon wind field, the friction should be taken into account.

Let the angle between the wind vector due to the friction with sea surface and the tangent of a typhoon in the polar coordinates be α , it can be obtained from Figure 1 that:

$$\begin{cases} fV_D + \frac{V_D^2}{R} = \frac{1}{\rho} \frac{\partial P}{\partial R_0} \cos \alpha & (3) \\ 0 = -\frac{1}{\rho} \frac{\partial P}{\partial R_0} \sin \alpha + \frac{1}{\rho} \frac{\partial \tau}{\partial s} & (4) \end{cases}$$

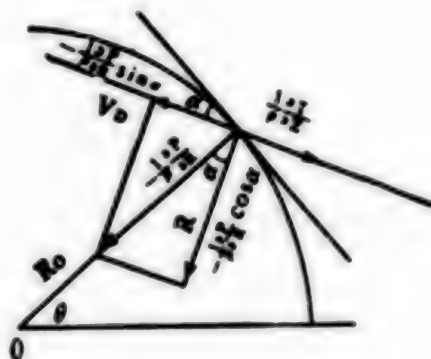


Figure 1

The origin 0 of the polar coordinates represents the center of a typhoon; V_D the wind velocity at a certain location within the typhoon when the moving speed of the whole typhoon system reaches zero after the friction with sea surface is taken into account; R_0 the distance from the location to the center; R the radius of curvature of the point-mass motion trajectory of air at the location. The frictional force of sea surface τ is:

$$\tau = C_D \rho V_D^2 \quad (5)$$

where C_D is the drag force coefficient of sea surface.

By choosing the wind velocity at locations 10 meters above the sea level as the wind velocity at the sea level, ρ can be treated as constant between the sea level and 10 meters above it. Thus:

$$\frac{\partial \tau}{\partial z} = 2C_D \rho V_D \frac{\partial V_D}{\partial z} \quad (6)$$

Prandtl has pointed out that the changes of wind in the immediate vicinity of the ground can be expressed logarithmically. According to Patterson[1], the following can be derived:

$$\frac{1}{\rho} \frac{\partial \tau}{\partial z} = \frac{2C_D^2}{kz} V_D^2 \quad (7)$$

where k is a dimensionless coefficient and z altitude from the sea surface.

Substitute (7) into (4) to obtain the following:

$$\left\{ \begin{aligned} fV_D + \frac{V_D^2}{R} - \frac{1}{\rho} \frac{\partial P}{\partial R_s} \cos \alpha \end{aligned} \right. \quad (3')$$

$$\left\{ \begin{aligned} \frac{2C_D^2 V_D^2}{kz} - \frac{1}{\rho} \frac{\partial P}{\partial R_s} \sin \alpha \end{aligned} \right. \quad (4')$$

From (3') and (4'), one gets:

$$\left(\frac{4C_D^2}{k^2 z^2} + \frac{1}{R^2} \right) V_D^4 + \frac{2f}{R} V_D^2 + fV_D - \left(\frac{1}{\rho} \frac{\partial P}{\partial R_s} \right)^2 = 0 \quad (8)$$

Equation (8) is a monadic quartic equation with real coefficients that can be solved. The solution can be expressed as:

$$V_D = F\left(R, C_D, \frac{\partial P}{\partial R_s}\right) \quad (9)$$

Equation (9) represents the distribution of typhoon wind field when the moving speed of the typhoon system is zero after the friction with sea surface is taken into account.

Actual observations indicate that the stalling of a typhoon is only temporary. It moves most of the time, occasionally with great speed. In fact, the speed and direction of a typhoon's movement have impact on the distributions of various elements of typhoon.

Assume a typhoon system moves with a velocity U and let's take as the starting position of the moving path of the typhoon's polar coordinates a point to

the right of and perpendicular to the velocity vector U , then, it can be seen from Figure 2 that:

$$\mathbf{V} = \mathbf{V}_D + \mathbf{U} \quad (10)$$

Or in scalar form:

$$\begin{cases} V_\theta = V_D \cos \alpha + U \cos \theta \\ V_R = -V_D \sin \alpha + U \sin \theta \end{cases} \quad (11)$$

$$V = \sqrt{V_\theta^2 + V_R^2} \quad (12)$$

$$V = \sqrt{V_\theta^2 + V_R^2} \quad (13)$$

where V_θ is the tangential velocity of typhoon which is positive counter-clockwise and negative clockwise; V_R the radial velocity of typhoon, which is positive outward and negative inward; θ the angle between the velocity of the typhoon system U and the tangent to the polar coordinates of the typhoon.

Equations (11), (12) and (13) are the required mathematical forms of typhoon wind field at the sea level.

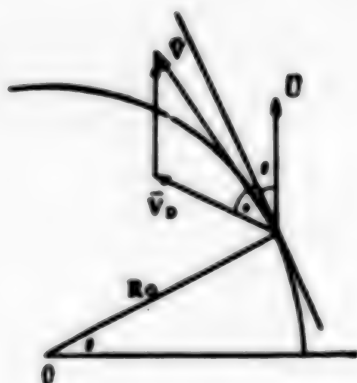


Figure 2

II. Mathematical Model of the Typhoon Divergence Field at the Sea Level

The continuous equation in the cylindrical coordinates system is:

$$\frac{\partial \rho}{\partial t} + \frac{1}{R_0} \left[\frac{\partial (\rho R_0 V_R)}{\partial R_0} + \frac{\partial (\rho V_\theta)}{\partial \theta} \right] + \frac{\partial (\rho W)}{\partial z} = 0 \quad (14)$$

For a typhoon-scale weather system, one can assume that ρ is constant at the sea level so equation (14) can be simplified as:

$$\frac{1}{R_0} \left[\frac{\partial (R_0 V_R)}{\partial R_0} + \frac{\partial V_\theta}{\partial \theta} \right] + \frac{\partial W}{\partial z} = 0 \quad (15)$$

And horizontal divergence as:

$$D_s = \frac{1}{R_s} \left[\frac{\partial(R_s V_{\theta})}{\partial R_s} + \frac{\partial V_r}{\partial \theta} \right] \quad (15')$$

Substituting (11) and (12) into (15'), one gets:

$$D_s = - \left(\frac{\partial V_D}{\partial R_s} + \frac{V_D}{R_s} \right) \sin \alpha \quad (16)$$

Equation (16) is the mathematical model for the horizontal divergence field of typhoon at the sea level.

The moving velocity of typhoon U is not included in the divergence field model. But this does not imply that U has no impact on the distribution of divergence field. Rather, it influences the distribution of divergence field indirectly through the term C_D . C_D is a function of wind velocity. Taking into consideration the moving velocity of typhoon systems, it becomes obvious from equations (11), (12) and (13) that wind field is dependent on α and θ , namely:

$$V = V(V_D, \alpha, \theta)$$

The distribution of typhoon wind field is not symmetrical so naturally that of C_D is also not symmetrical. The incident angle α of typhoon wind field is related to C_D so the distribution of incident angle α is also not symmetrical. As a consequence, the distribution of typhoon divergence field is asymmetrical. This can be clearly seen from equation (16).

III. Examples

The distribution of typhoon pressure field is described by the Myers equation[3]:

$$P = P_n + (P_0 - P_n) e^{-\frac{R_0^2}{R_s^2}} \quad (17)$$

where P is the pressure at a point whose distance to the center is R_0 ; P_n the ambient pressure of typhoon that is not under the influence of the typhoon system; P_0 the lowest pressure at the center and R_m the radius of the maximum velocity region.

Assume $P_n = 1004$ mPa, $P_0 = 930$ mPa, $R_m = 20$ km, $U = 15$ km/hr, and $\rho = 1.16 \times 10^{-3}$ g/cm³, calculate the distributions of typhoon wind and divergence fields at the sea level.

*When the effect of typhoon's velocity is taken into account, the resulting wind and divergence fields become asymmetrical. As a result, the distribution of pressure field also appears asymmetrical. Using the Myers equation here is merely an approximation.

1. Calculations of the Distribution of Wind Field

The calculation of the distribution of wind field is done in two steps:

(1) Calculate from equation (2) the distribution of the wind field when the moving speed of typhoon is zero and the effect of friction is not considered. Based on this distribution, the corresponding distribution of C_D can be obtained from Figure 3.

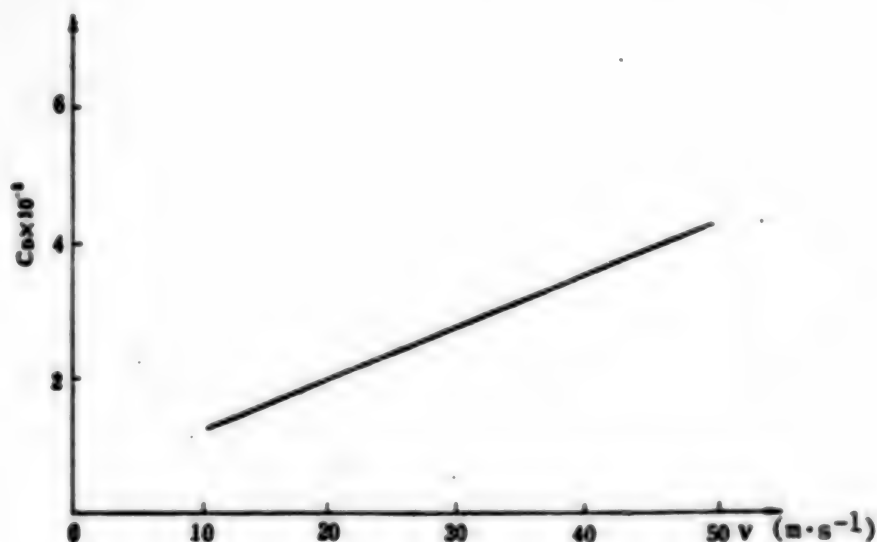


Figure 3. The $3C_D$ - V curve.

Figure 3 shows the changes of C_D with wind velocity. The curve is the average of Miller's curve[5] and that from the following equation[2]:

$$C_D = (0.5 + 0.06V) \times 10^{-3} \quad (18)$$

It is a reasonable curve within the range of $V = 10$ - 50 m/s [2,5].

With the distribution of C_D on hand and substituting the V_D in equation (4') with V_{gr} , the approximate values of α' and subsequently the approximation $R = R_0 \cos \alpha'$ can be obtained. The calculated C_D and R are then substituted into equation (8) to get the distribution of V_D when the moving speed of typhoon system is zero after the friction with sea surface is considered. The distribution of α is obtained by substituting C_D and V_D into equation (4'). The distributions of C_D , V_D and α obtained are all symmetrical.

(2) Through equations (11), (12) and (13), the asymmetrical distribution of V is obtained by using the symmetrical distributions of V_D and α . From this distribution of V , the corresponding asymmetrical distribution of C_D can be obtained from Figure 3. Feed these asymmetrical distributions of C_D into equation (8) and solve the equation to get the asymmetrical distribution of V_D . Then, the asymmetrical distribution of α that corresponds to the

asymmetrical distribution of V_D can be obtained from equation (4'). After the asymmetrical distributions of V_D and α are obtained, the distribution of typhoon wind field under the condition that the moving speed of typhoon system is not zero and the effect of the friction with sea surface is considered can be derived from equations (11), (12), and (13). Thus, the calculations of the wind field are completed. For a more accurate wind field, steps (1) and (2) can be repeated several times to reach the desired accuracy.

2. Calculations of Typhoon Divergence Field at the Sea Level

After the distribution of typhoon wind field at the sea level is obtained, it is easy to obtain the distribution of divergence field at the sea level. By substituting the calculated asymmetrical distributions of V_D and α into equation (16), the distribution of typhoon horizontal divergence field at the sea level can be obtained. It is obvious that the distribution of D_h is also asymmetrical.

There apparently is no problem when a computer is used to solve the above-mentioned equations for the distributions of typhoon wind and divergence fields at the sea level. But it is a rather laborious task when carried out by hand or an electronic calculator. The major problem lies in solving equation (8). In order to simplify the calculations, solving equation (8) is replaced with solving a coefficient B , namely:

$$V_D = BV_p \quad (19)$$

This does not result in large error. Now let's derive the expression for B .

Replacing gradient wind equation with a whirlwind equation, equations (3') and (4') can be simplified:

$$\frac{V_p^2}{R} = \frac{1}{\rho} \frac{\partial P}{\partial R_0} \cos \alpha \quad (20)$$

$$\frac{2C_D V_p^2}{kz} = \frac{1}{\rho} \frac{\partial P}{\partial R_0} \sin \alpha \quad (21)$$

From (20) and (21) one gets:

$$V_D = \sqrt{\frac{s}{\sqrt{s^2 + 1}}} \frac{R}{\rho} \frac{\partial P}{\partial R_0} \quad (22)$$

where:

$$s = \frac{2C_D V_p R}{k}$$

Let:

$$B = \sqrt{\frac{x}{\sqrt{x^2 + z^2}}}$$

$$V_D = B \sqrt{\frac{R}{\rho} \frac{\partial P}{\partial R_0}} = BV_{rot} \quad (22')$$

V_{rot} is the velocity of whirlwind when the effect of friction is not taken into account. Substituting V_{gr} for V_{rot} in equation (22') results in equation (19).

In the calculations of the distribution of typhoon horizontal divergence field at the sea level, gradient wind equations can be reduced to whirlwind equations when the calculations are for the area near the maximum speed zone of typhoon where wind speed is very large and R small. That is equations (20) and (21) are valid. Then, the horizontal divergence is:

$$D_A = - \left[\frac{x}{2} \frac{\frac{x^2}{\rho} \frac{\partial P}{\partial R_0} + \frac{R}{\rho} \frac{\partial^2 P}{\partial R_0^2} (x^2 + z^2)}{(\sqrt{x^2 + z^2}) \sqrt{\frac{x^2}{\rho} \frac{\partial P}{\partial R_0}}} + \frac{BV_{rot}}{R_0} \right] \sin \alpha \quad (23)$$

We used a computer to carry out calculations and solved equation (19) instead of equation (8). Except for the additional calculations for the distributions of α and B , the rest is the same as described before. The distribution of typhoon wind field at the sea level is shown in Figure 4 and the distribution of incident angle α at the sea level is shown in Figure 5. Figure 6 shows the distribution of typhoon horizontal divergence field at sea level.

IV. Comparisons With the Observed Situations

It can be seen from Figure 4 that, at the same radius, the wind velocities within a typhoon system are greater at the rear right side of the direction of typhoon movement and smaller at the front left. With the radius shrinking toward the maximum speed region, the larger and smaller speed areas are gradually approaching the exact right and left of the center, respectively. The maximum speed appears at a distance R_m to the right of the center. The distribution of the typhoon wind field is obviously asymmetrical and the strong wind region, maximum speed region and the eye are well defined. All these are consistent with what have been observed of a majority of typhoons. Figures 7[4] and 8[4] show the actual wind fields of Hurricanes Carre (17 September 1957) and Daisy (25 August 1958), respectively, as surveyed by U.S. airplanes. By comparing Figure 4 with Figures 7 and 8, it can be seen that the wind field model agrees well with the observed.

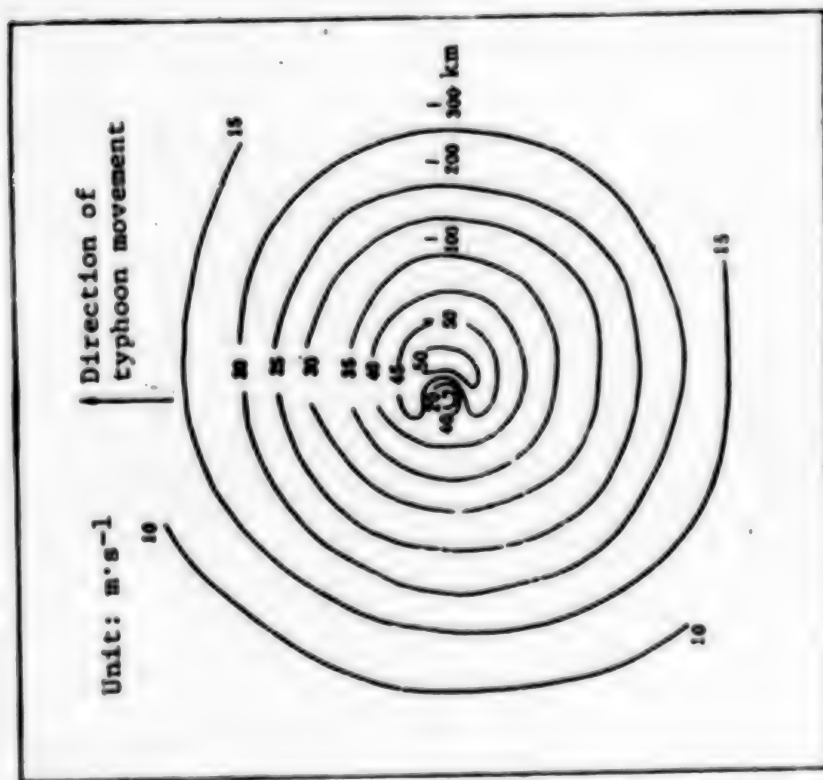
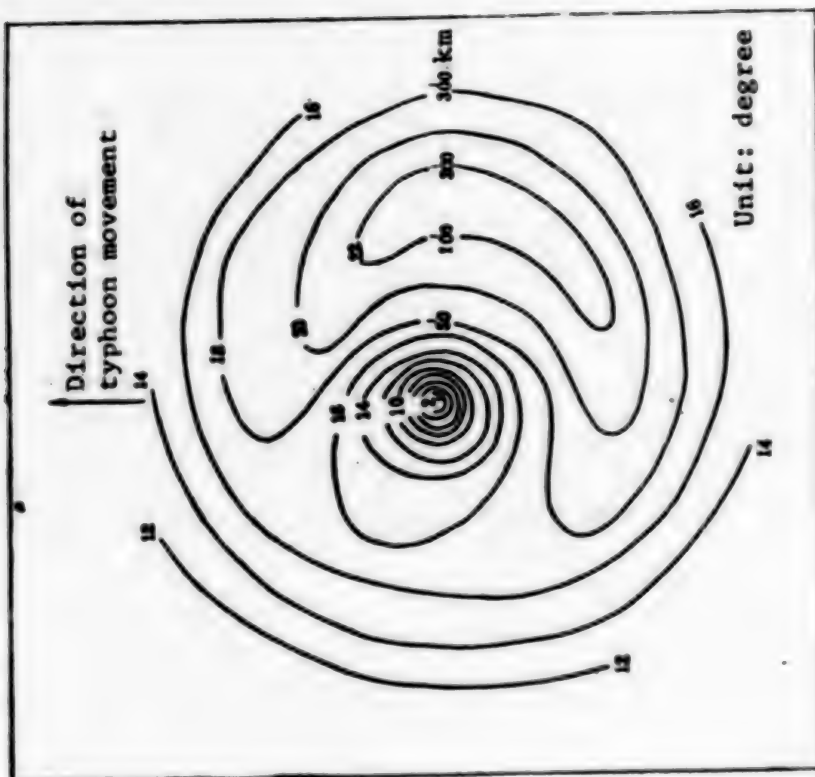


Figure 4. The typhoon wind field at the sea level. (The scale is reduced by half for the radius range 100-300 km.)



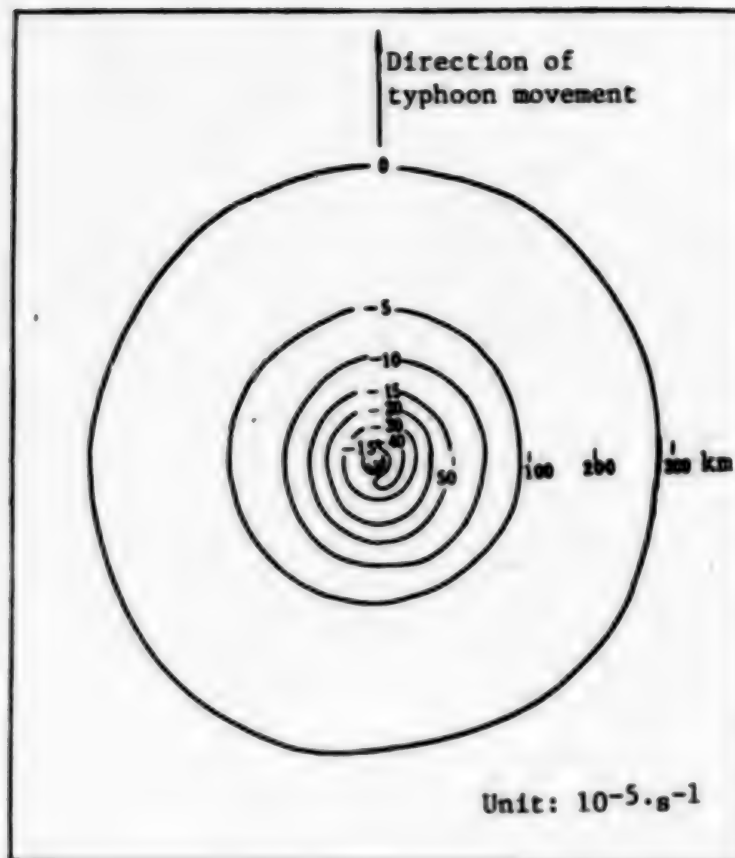


Figure 6. The typhoon divergence field at sea level. The value of innermost circle is -15 and that of the one next to the innermost circle is -30. (The scale is reduced by half for the radius range 100-300 km.)

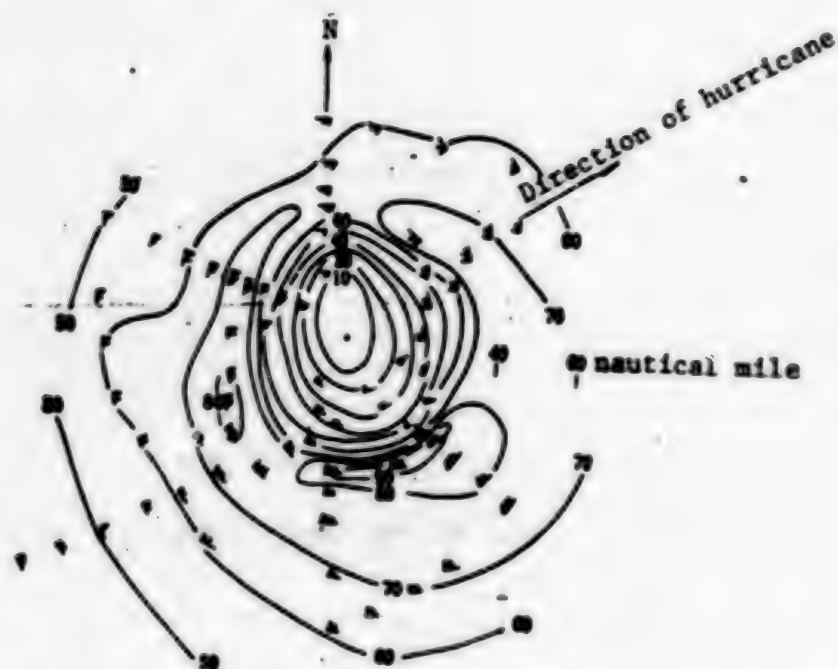


Figure 7. The distribution of constant wind velocity (nautical mile/hr) curves at 690 mPa of Hurricane Carrie (1975). (From Gray)

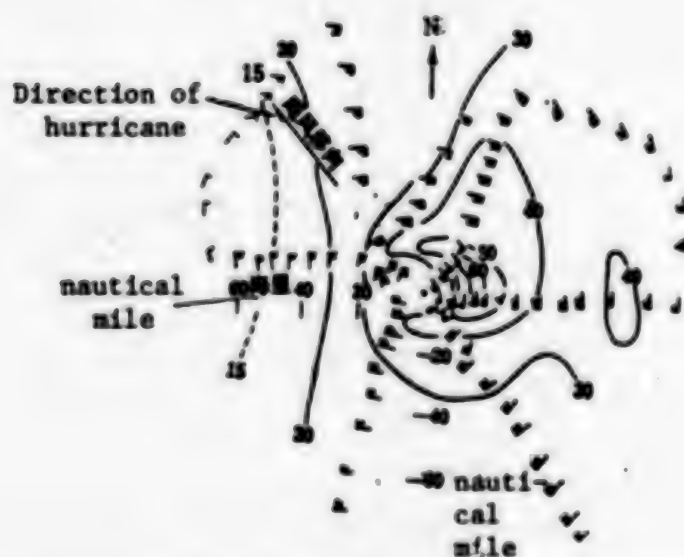


Figure 8. The distribution of constant wind velocity (nautical mile/hr) curves of Hurricane Daisy (1958). (From Gray)

Like the distribution of wind field, the distribution of typhoon horizontal divergence field at the sea level is also asymmetrical. Outside the cloud wall, the convergence increases with decreasing radius and it diverges at the distance of 300 km. Inside the cloud wall, it decreases with decreasing radius and the eye is clearly defined. It can be seen from Figure 6 that

the cloud wall is located at the maximum radial convergence which coincides with the location of the maximum speed zone. Figure 6 agrees with the facts that there are stronger wind and greater precipitation at the right side of the direction of typhoon movement, and that heaviest precipitation occurs at the right cloud wall. Figure 9[6] is the enhanced infrared picture of Hurricane Gladys taken by a U.S. synchronous satellite. By comparing Figures 6 and 9 it can be seen that the distributions of their convergence areas agree with each other.

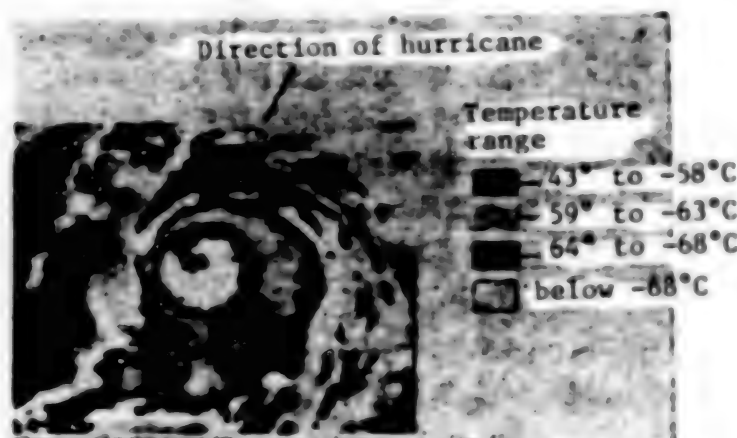


Figure 9. The enhanced infrared picture of Hurricane Gladys (1975) taken by a synchronous satellite. (From Kreps)

V. Discussions

In this article, the effect of typhoon's velocity and the friction with sea surface are taken into account and it is found that the speed and direction of typhoon's movement cause the distortion of the distribution of typhoon wind and divergence fields. Figure 10 shows the distributions of the wind and divergence fields, which are symmetrical, when the moving speed of typhoon is zero. The friction with sea surface causes the mass convergence when the wind passes the isostatic lines. In our model, it can be obtained from equations (3) and (4) that the wind will be parallel to the tangent of the polar coordinates, the incident angle α is zero and the convergence is zero when the effect of friction is ignored.

Solving equation (19) instead of equation (8) will create some errors in the strong wind region. But the wind speed and C_p there are not very large and B is closer to 1, therefore the errors are not significant. And it is reasonable to replace equation (8) with equation (19) within the maximum speed zone because here the gradient wind equation is reduced to a simple whirlwind equation.

After repeated calculations, we find that the results using $k = 6$ fit better with the reality. Here the effect of atmospheric circulation on typhoon is not considered.

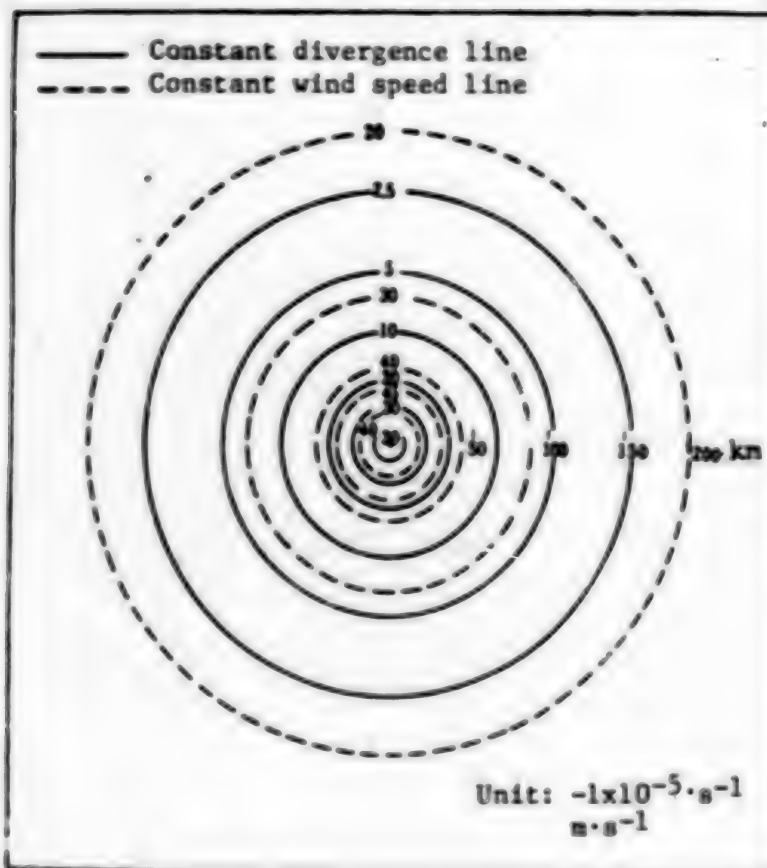


Figure 10. The wind and divergence fields at the sea level of a stalling typhoon.

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PHYSICAL SCIENCES

SEA-AIR HEAT EXCHANGE NEAR XISHA ISLANDS STUDIED

Beijing NANHAI HAIYANG KEXUE JIKAN [NANHAI STUDIA MARINA SINICA] in Chinese
No 3, Jul 82 pp 91-97

[Article by Chen Tegu [7115 3676 0942], Nanhai Oceanography Institute,
Chinese Academy of Sciences; paper received 30 January 1980]

[Text] There exists a continuous heat-exchange process at the sea-air interface. Studying its rule of changes will help us understand the temperature changes of sea water, figure out the cold and warm advections of ocean, and unravel the relationship between sea and air. For South China Sea, so far little has been done in this area. Based on marine meteorological observations by merchant vessels, calculations have been made by K. Wyrski (1957)[6], K. Hishida and K. Nishiyama (1969)[7], and the Marine Meteorology Section of the Oceanography Institute of the Chinese Academy of Sciences (1979)[4]. Because different data and approaches were used, the calculation results are quite different. In this article, we use the formulas that we have modified and improved to calculate the monthly averages of the overall sea-air heat exchange and its components in the waters around the Xisha Islands. Preliminary analysis of the basic features of overall heat exchange and its correlation with sea temperature were made. Thus provides information for carrying out the study of oceanic thermal structure of the waters of this region and the prediction of water temperature.

I. Methods and Data

The overall sea-air heat exchange (Q_n) means the total heat exchanged between ocean and atmosphere through their interface. Also termed net heat exchange, it is the algebraic sum of the total solar radiations that enter the ocean (Q_s), the effective back radiation of sea surface (Q_b), the latent heat exchange (Q_e) and the sensible heat exchange (Q_c) as expressed by the following equation:

$$Q_n = Q_s - Q_b - Q_e - Q_c = Q_r - (Q_e + Q_c) \quad (1)$$

where Q_r is the radiation equilibrium, also termed net radiation.

There are many approaches to calculate the climatological terms on the right side of equation (1). Based on the hydrological and meteorological features of the waters of this region, the following equations are used in this article (energy is expressed in cal/cm²·day).

1. Total Solar Radiations Entering the Sea (Q_s)

The equation used is:

$$Q = Q(1 - r) \quad (2)$$

where Q is the total solar radiations that actually reach the sea surface; r the monthly mean reflectance of the surface. Data from reference [2] were used.

There are numerous equations for calculating Q . To select the equations that are appropriate for the situations of China, Wang Bingzhong [3769 3521 1813] and Zhang Fuguo [1728 1381 0948]* have screened 21 different equations, including those used in references [4], [6], and [7], and recommended the one that gives the smallest errors:

$$Q = Q_0(a + bS_0) \quad (3)$$

where Q_0 is the total solar radiations through ideal atmosphere (also called dry and neat atmosphere) and the data of Wang Bingzhong's were used; a and b are proportional coefficients that are related to the cloud conditions (cloud forms, cloud distributions and daily variations of cloud), degree of transparency, and vapor content; S_0 is sunshine percentage.

There is no observation record of solar radiation at the Xisha Station. The nearest solar radiation observation station is the Haikou Station. Considering the fact that their major climate patterns are by and large identical and that the monthly variations of Q_0 and S_0 at both locations are also similar or close (data not shown), we believe that it is feasible to use the a and b values at the Haikou Station in our calculation of Q for the waters near the Xisha through equation (2).

Based on the 1961-1978 data of Haikou Station, linear regression was employed to obtain $a = 0.12$ and $b = 0.65$ (see Figure 1). The correlation coefficient is 0.98.

The relative errors of the Q values of each month at Haikou Station as calculated from equation (3) are within 5 percent and the monthly variations are very close to the observed values (Figure 2), proving that the calculation results are satisfactory.

*Wang Bingzhong and Zhang Fuguo, "Preliminary Investigation of the Calculation Methods for the Total Solar Radiations at Qinghai-Tibet Plateau and Other Areas of the Same Latitude."

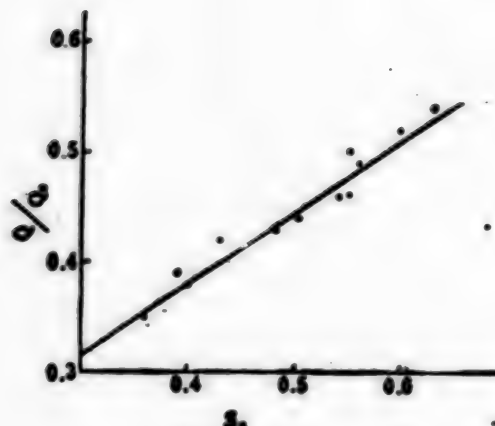


Figure 1. The correlation of sunshine percentage with the monthly solar radiations that reached the surface of the Haikou Station (1961-1978).

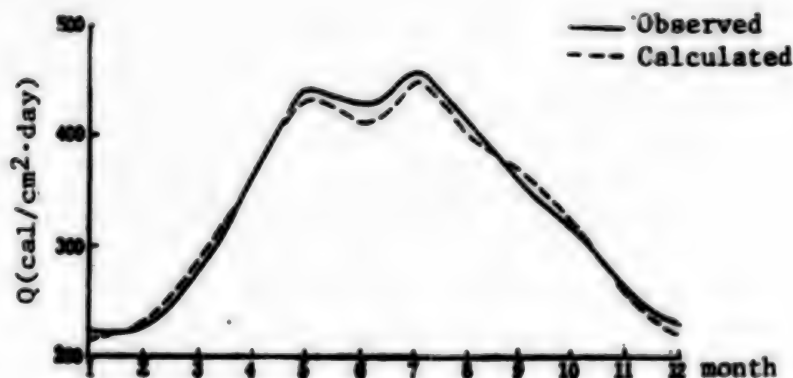


Figure 2. The calculated and observed values of the monthly total solar radiations reached the surface of Haikou Station.

Finally, the empirical formula for calculating the Q_s of individual month in this region is the following:

$$Q_s = Q_0(0.12 + 0.65S_s)(1 - r) \quad (4)$$

2. Effective Back Radiation (Q_b)

The equation of M.E. and T.G. Berlyand^[1] was used.

$$Q_b = S\sigma\theta_a^4(0.39 - 0.06\sqrt{e_a})(1 - KC^2) + 4S\sigma\theta_a^3(T_w - T_a) \quad (5)$$

where S is the ratio of long-wave radiation and black-body radiation of the surface, a value of 0.94 was chosen; σ the Stefan-Boltzmann constant, whose value is 1.18×10^{-7} cal/cm²·day·degree⁴; θ_a absolute temperature of surface air; T_w and T_a are sea water temperature and air temperature (°C); e_a is vapor pressure of air (mPa); K cloud coefficient and the data from reference

[2] were used; and C the total cloud cover, whose value is 1 when it is completely covered with cloud.

3. Latent Heat Exchange (Q_e) and Sensible Heat Exchange (Q_c)

The following equations were used, respectively

$$Q_e = \rho_a C_d L (g_w - g_a) V \quad (6)$$

$$Q_c = \rho_a C_d C_p (T_w - T_a) V \quad (7)$$

where ρ_a is air density, whose value is 1.16×10^{-3} g/cm³ for this region; C_d wind-stress coefficient of sea surface, whose value is 1.4×10^{-3} ; L the heat of vaporization of water and is calculated from $(597 - 0.56 T_w)$ cal/g; g_w and g_a are the specific humidity (g/kg) of saturated water and air at sea surface temperature, respectively; V is wind speed (m/s); T_w and T_a are the same as described earlier; C_p is the specific heat of air at constant pressure, whose value is 0.24 cal/g·degree.

Equations (6) and (7) are the well-known total transport equations. The determination of C_d values in the equations is an important yet complicated matter. Because the instruments and approaches are not standardized, the measured values are quite different and so far there is no universally accepted value. Numerous observations and studies since the 1970's have shown that, under normal wind condition, the value is between $(1.0-2.0) \times 10^{-3}$. We have compared the data presented in references [8-10] and believe that the value of 1.4×10^{-3} is appropriate for this region. This value agrees well with the average value for Yangpu Bay at the west coast of Hainan Island under 2-7 m/s wind, which was measured by Wu Houshui^[3] [0702 0624 3055] using the wind speed contour method.

With the exception of wind speed, all the hydrological and meteorological data are obtained from the Xisha Marine Station (1961-1978). The monthly mean wind speed is obtained from the observation data of the passing merchant vessels. Due to the effect of topographical features, the monthly mean wind speed at the Xisha Station during winter season is noticeably smaller than those over the surrounding waters. The observation data of merchant vessels basically reflect the wind situation at sea.

II. The Analysis of the Characteristics of Sea Surface Heat Equilibrium

The waters near the Xisha Islands are located within the Southeast Asia Monsoon region and have tropical monsoon climate. Near the surface, it is predominantly northeasterly wind from October to next March and southwesterly wind from May to August. April and September are the transition months for monsoon. It is hot and humid year-round but the dry and wet seasons are distinctive. The cumulative temperature of the days with a mean temperature of $\geq 10^\circ\text{C}$ is over 9500°C. Figure 3 shows the monthly variations of each component of sea-air heat exchange under tropical monsoon.

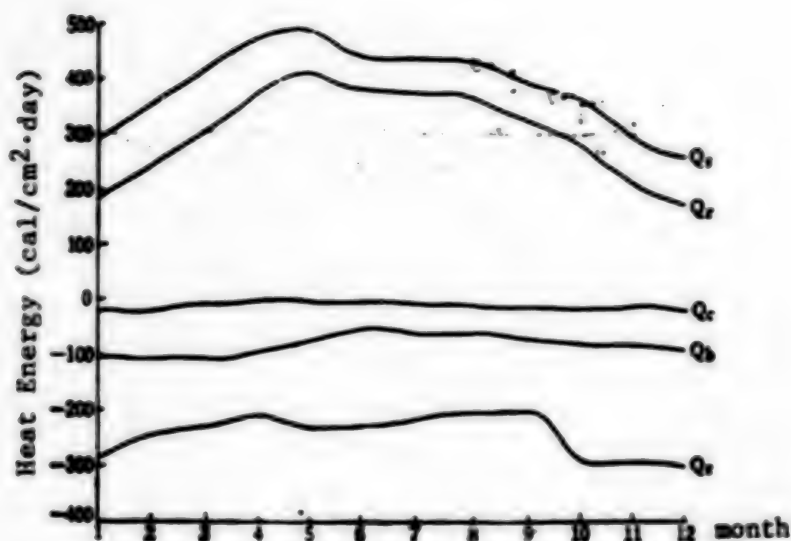


Figure 3. The monthly variations of each component of sea surface heat equilibrium of the waters near the Xisha Islands.

1. Total Solar Radiations Reaching the Sea Surface

There are abundant solar radiation heat (Q_s) in these waters. Even at the month with the lowest value (December), there are still $260 \text{ cal/cm}^2\cdot\text{day}$. The highest value appears in May, nearly $500 \text{ cal/cm}^2\cdot\text{day}$. The annual total reaches $140 \text{ Kcal/cm}^2\cdot\text{day}$. The solar energy absorbed per square meter per year is equivalent to the heat generated by burning 200 kg of standard coal (heat content $7,000 \text{ Kcal/kg}$). The solar radiation is the major channel that ocean gets heat from atmosphere. Because the seasonal changes of the monthly mean reflectance of sea surface are very small, the monthly variations of Q_s are mainly determined by those of the total radiation through ideal atmosphere Q_0 and sunshine percentage S_0 . As to the changes from year to year, it is mainly determined by the changes of S_0 .

2. Effective Back Radiation and Radiation Equilibrium at Sea Surface

In this region, the effective radiation Q_b for each month is between $50\text{--}100 \text{ cal/cm}^2\cdot\text{day}$ with moderate monthly variations. This is because the important determining factor of Q_b --air temperature is related to the absolute humidity. When temperature rises, so does absolute humidity and vice versa. When both of them rise and fall together, they have exactly the opposite effects on Q_b and cancel each other out. Because the seasonal changes of Q_b are small, the monthly variations of radiation equilibrium are basically similar to that of Q_s . The radiation equilibrium of each month has positive value but the monthly fluctuations are large. It exceeds $400 \text{ cal/cm}^2\cdot\text{day}$ for high value months and is only $160 \text{ cal/cm}^2\cdot\text{day}$ for low value month. The yearly total is 110 Kcal/cm^2 . The atmosphere of this region serves as heat source year-round.

3. Latent Heat Exchange and Sensible Heat Exchange

The average daily totals for each month are between 220-320 cal/cm²·day with strong monthly fluctuations. The low value period appears during the time of changing monsoon and the high value period appears in winter months. This has to do with the strong winds in winter (Figure 4). The differences in the vapor pressures and temperatures of sea and air fluctuates within a small range throughout the year in this region. But the variation range of monthly mean wind speed is over 3 m/s. Therefore, the atmospheric circulation becomes the primary factor in determining the monthly variations of ($Q_e + Q_c$).

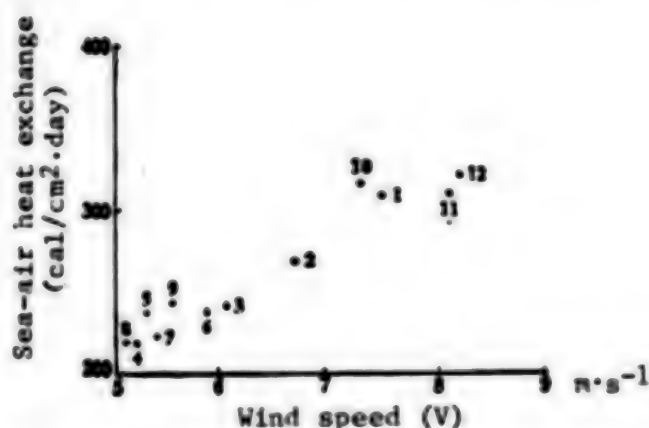


Figure 4. The relationship between the wind speed and the flux of sensible and latent heat of each month. (Numbers by the dots denote month)

Calculations show that sensible heat exchange is only 5 percent of the latent heat exchange for all months and this is mainly because C_p is four orders of magnitude smaller than L . Besides, the fact that $(T_w - T_a)$ often is an order of magnitude smaller than $(e_w - e_a)$ in this region is another reason.

4. Overall Sea-Air Heat Exchange Q_n

As shown in Figure 5, Q_n has marked monthly variations. From March to September, $Q_n > 0$ and from October to next February, $Q_n < 0$. The former corresponds to the summer monsoon season while the latter the winter monsoon season.

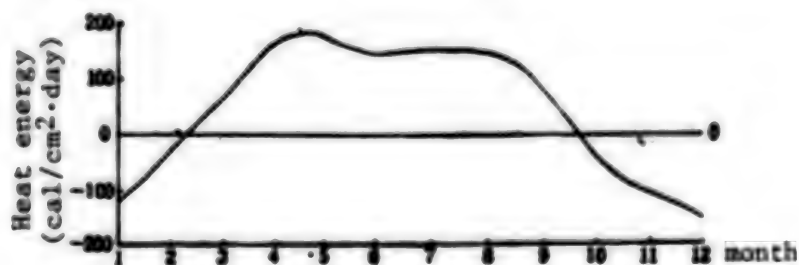


Figure 5. The monthly variations of heat equilibrium in the waters around the Xisha Islands.

It can be seen from Figure 3 that the changing trends of the pairs— Q_n , Q_s and Q_n , $(Q_e + Q_c)$ are roughly identical. Because there exists a positive correlation between V and $(Q_e + Q_c)$ (see Figure 4), there also exists a close correlation between Q_n and V (data not shown). These indicate that the monthly variations of the overall heat exchange in this region are mainly affected by solar radiation and the seasonal changes of atmospheric circulation. As far as the monthly changes are concerned, there is no doubt that atmospheric circulation is the primary factor. On the one hand, atmospheric circulation affects the degree of cloudiness, and the changes in sunshine percentage in turn affect the solar radiations that hit the surface. On the other hand, it affects the release of heat from the surface through its impact on latent and sensible heat exchanges, particularly the former.

III. Overall Sea-Air Heat Exchange and Water Temperature Change

The sea-air heat exchange is one of the important factors that affect water temperature. But it is a complicated relationship. Because of the lack of a complete and systematic hydrological record, only qualitative analysis of surface temperature changes is made here.

Let's define the surface water temperature increment ΔT_i for the i th month as:

$$\Delta T_i = T_i - T_{i-1} \quad (8)$$

where T_i is the mean surface temperature of the i th month in this region. When the monthly variations of Q_n and ΔT_i are compared (Figure 6), it is found that there exist certain correlations: 1) With the exception of February, the months with $Q_n < 0$ have $\Delta T < 0$, the temperature drops are greater than 1°C . 2) In the months with $Q_n > 0$ the changes of ΔT are more complicated. The ΔT s of March, April and May are greater than 1.5°C while the changes of the months between June and August are between $\pm 0.1^\circ\text{C}$, basically in a constant temperature state. Particularly noteworthy is that the Q_n values of the months between April and August are $140\text{--}170 \text{ cal/cm}^2\cdot\text{day}$, the difference being $20\text{--}30 \text{ cal/cm}^2\cdot\text{day}$. But their ΔT s are greater than 1.5°C . We speculate that there are marked changes of advections and vertical mixing convections during these months. For February, $Q_n < 0$ and $\Delta T > 0$, indicating the influence of warm advections with the higher temperature waters coming from Bashi Channel and southeastern South China Sea. For September, $Q_n > 0$ and $\Delta T < 0$. This may be due to its small Q_n value, frequent typhoon activities and the influence of weak, cold advections.



Figure 6. The correlation of the changes in Q_n and ΔT of the waters near the Xisha Islands.

Judged by the monthly variations of Q_n and ΔT , February and September can be deemed as the transition periods in the changes of water temperature in this region.

IV. Conclusions

Based on the above analysis, we can reach the following preliminary conclusions:

- (1) There are obvious seasonal changes in the overall sea-air heat exchange (Q_n) in the waters near the Xisha Islands. In general, the Q_n values are positive during the summer monsoon season and negative during the winter monsoon season. This is mainly due to the seasonal changes in solar radiation and atmospheric circulation.
- (2) The solar radiations entering the sea surface is the major pathway that ocean gets heat from atmosphere. The major mode that ocean loses heat to atmosphere is through latent heat exchange. Then there are also the effective back radiation of the surface and sensible heat exchange. Their proportions are 70-75 percent, 25-20 percent and 5 percent, respectively.
- (3) The overall sea-air heat exchange is an important factor affecting the surface temperature change in this region. Except for the transition periods (February and September), when $Q_n < 0$ surface temperature drops and when $Q_n > 0$ surface temperature rises or remains constant for all months.

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APPLIED SCIENCES

DATABASE FOR NORTHEAST POWER SYSTEM

Shenyang XINXI YU KONGZHI [INFORMATION AND CONTROL] in Chinese Vol 14, No 2, 1985 pp 22-27

[Article by Zhang Jiayin [1728 0857 7299] of Shenyang Institute of Automation, Chinese Academy of Sciences: "A Microcomputer Chinese Database System and Its Application to Northeast Power System of China"*]

[Text] English Abstract: The most serious problem of a Chinese character microcomputer database system is its low speed which will deter its use; this key problem has been solved by developing a new Chinese word searching technique, the "tag field method," which makes the searching speed nearly 10 times higher than it was before. Combining with some other steps, such as consecutive query at the same layer, we can save a substantial amount of storage space and extend the application area of microcomputers. The database system recommended in this paper is very suitable for end users. Anyone, even if he knows nothing about computers, will be able to use it successfully within a few minutes.

I. Overview

The Northeast Power System, which is made up of over 100 hydro and thermal power plants and high tension substations in Liaoning, Jilin, Heilongjiang and Inner Mongolia and the high tension and ultra-high tension transmission lines which link them together, is one of China's largest power networks. It is a complex system consisting of such important equipment as over 1,000 synchronous generators, transformers, turbines, boilers, high tension switches and transmission lines. The General Dispatch Bureau which is located in Shenyang directs the entire Northeast Power System round the clock to ensure that safe and reliable electric power is supplied for industrial and agricultural production and domestic needs for the entire northeast. To carry out this direction correctly and effectively, dispatchers must constantly check on the parameters of important equipment in the power plants and substations, such as generator or transformer type and capacity, rated output

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of turbines, high pressure steam output per hour of the boilers, the serial number, rated voltage, and location of high tension switches, and the identifiers, length, number of poles, type of wires, safe current, and maintenance units of the transmission lines. The "Northeast Power System Primary Equipment Parameter Chinese Character Database" implemented on a Chinese-manufactured ZD-2000 microcomputer was developed for this purpose.

This software package adopted a completely hierarchical modular structure. The entire system is divided into two parts: the program region and the data region. The program region takes up 126 K bytes and the data region takes up 198 K bytes (this can be expanded as necessary). The program region is made up of 62 modules in seven layers. Coding was from top down, debugging was from bottom up. The data region is made up of the main database and four auxiliary databases.

In order to reach a degree of practicability when we developed the software, we adopted a series of measures which not only effectively improved search speed, but also saved a great deal of memory and made things as easy as possible for the user.

II. Structure and Features of the Software Package

See Figures 1 through 6 for block diagrams of this software package's programming. The user can carry out a search by power plant, substation or equipment name. Power plant mode is divided into hydroelectric plant and steam power plant, and steam power plant is divided into those subordinate to the Electric Bureau and those which are operated by factories and enterprises. In substation mode, a search can be carried out by province (region) and special searches can be made for substations owned by factories and enterprises or for substations which have special transformers (auto-transformers or with negative load voltage regulators). Under equipment name mode there are seven sub-branches: generator, phase modulator, transformer, boiler, turbine, transmission line and high tension switch.

This software package uses only Chinese for dialogue with the user. On the basis of the Chinese "menu" which appears on the CRT, the user can use the number keys 0-9 and the 26 letter keys to "choose from the menu," then that part of the data or information which the user needs is displayed on the CRT in Chinese characters in two dimension tabular form with many elements, for example, the name, serial number, size, capacity, location of each piece of equipment in a certain power plant or substation and the name of the power bureau to which it is subordinate. When the amount of data which must be displayed is large, it is automatically displayed in page format and after the user has viewed a page, with the press of any key on the keyboard, it can continue to display the contents of the next page. This is much more convenient for the user than the "rolling" display. After the display is completed, as necessary the user can decide whether or not to make a hard copy of the contents and print it out on a printer. Even people who do not understand computers can learn how to use it in a minute or two.

This software package has a certain "intelligence," that is, a logical judgment ability. For example, when the user "selects from the menu" and presses the wrong key, the CRT displays: "You entered the wrong character! Please try again." Then displays the same "menu" and asks the user to select from it again. When the user attempts to search other types of power plants than hydroelectric and thermoelectric plants, the CRT displays: "The Northeast Power System does not currently have other types of power plants!" When the user attempts to search other modes than the names of power plant and substation equipment, the CRT displays: "Please excuse us, we do not yet have this type of search mode."

Because a completely hierarchical modular structure was adopted, there is a completely one-way dependence between modules of each layer, and this improves the system's reliability. The correctness of the entire program system can be guaranteed by the correctness of the layers. Debugging proved that as long as one layer module was debugged, the next higher layer module had a reliable foundation and we only had to concentrate our energies on debugging just the next higher level and need not worry about the impact of the "counteraction" of the next lower level on the entire system. After going through each layer using this bottom-to-top debugging method the functions of the entire system could be fully implemented and thus avoided the difficulties encountered in debugging the system's "modular interface method" program and greatly shortened overall debugging time. Another advantage of this layered structure is that revising the program and expanding the functions are very easy, generally requiring only revision of the corresponding function module. Under certain circumstances, lower layers will also require suitable revision, but for other modules on the same layer and modules at higher layers, no changes are necessary. When expanding functions, modules can be added by stacking, and adding a major category to the "main menu" (for example, adding a fourth search mode) and the other modules need not be changed.

This software package ensures the sharing and independence of data. In the example of a special high tension switch, it can be searched by equipment name and by power plant (or electric substation). But what is found using different search modes is the same data item in the database. When a power plant or substation has new equipment on line or a new power plant, substation or transmission line has been built, it is only necessary to add the corresponding data item to the database and no changes need be made to program region.

The Chinese character CP/M operating system used by the system software supports DBASE-II. Its shortcoming is that it does not have a security function. For this reason, we have added this function to this software package. When the user tries to use this software, he must first enter the correct security code, otherwise the CRT displays: "You do not have user rights to this database!"

III. New Index Methods for Chinese Character Databases

As everyone knows, one of the most important problems in a microcomputer database is speed and because of the complexity of the search in a Chinese character microcomputer database, the speed is even slower, especially when the number of data entries in a Chinese character database exceeds 1,000 the average search time (the average of the time it takes from beginning to search the database until the necessary data appears on the CRT, same hereinafter) will increase to the point that the user cannot tolerate it (a good many minutes), and this creates difficulties in making a Chinese character microcomputer database practical. An index file of the key items which must be searched can be set up to resolve this problem, but search speed still will not meet demands and the order in which the Chinese character database index file is arranged frequently runs counter to the sequence required; what is more serious is that the memory which the index files take up may even have to be larger than the main database itself and this clearly is unacceptable. We have created a new method of setting up a "marker field" in the Chinese character database which resolves this problem so that the average time is reduced to about 20 seconds and the amount of memory occupied by each index file is only 10 percent to 20 percent of the memory occupied by the database itself. This improved the search speed by nearly 10-fold and at the same time also saved a great deal of memory in the data region. In addition, the "marker field" is used in the command file in place of encoding the corresponding Chinese character data items and also takes up a little less of the program region memory. What is more important is that after the "marker field" is set up, the sequence of arrangement of the index files can be changed in any way as needed, putting the most frequently used data items in the Chinese character database in the front and arranging those data items which are rarely used or for which a certain search mode is generally not used, at the very end, so that the average search speed is improved even more. For example, we can place the high tension lines and the equipment in the power plant and substations which are directly controlled by the general dispatch office in the front because this is a situation which often has to be searched. By the same principle, generators with large single-machine capacity and generators which are in large power plants should be placed in front, and those small power plants and small generators should be placed in back. When searching is in substation mode, all the generators, boilers and turbines are placed in the very back.

Another advantage to setting up the "marker field" is that a comprehensive index of many "marker fields" can be made. This reduces the number of program modules and simplifies the encoding process. For example, when carrying out a search by equipment name, four "marker fields" can be combined showing, respectively: whether or not it is controlled directly by general dispatch, whether it is equipment in a substation or equipment in a power plant, whether it is a hydroelectric power plant or a thermoelectric power plant, and whether it is subordinate to the electric power bureau or is owned by a factory; what province (region) it is in; for transformers, whether it is an ordinary transformer or a self-coupling or negative load voltage regulator transformer; for boilers, whether it is a high-temperature high-pressure boiler; for turbines, apart from indicating whether it is

high-temperature high-pressure, it can also show whether it is bleeder-heat supply or water circulating-heat supply; for high tension switches it will tell the voltage grade. After setting up this type of comprehensive index file, the functions illustrated in Figures 1-6 can be automatically implemented "at one shot." This is much easier than indexing by separate "menus" at each level and it also can reduce the amount of programming work.

IV. Measures Used To Save on Memory

Another important characteristic of microcomputer databases is that the memory capacity is small, therefore memory should be economized by all means possible. To this end, when developing this software package we took the following measures:

1. Setting Up a "Marker Field" in the Chinese Character Database

As mentioned above, in addition to clearly improving speed, this method also can save on a great deal of the memory occupied by the database region and the program region even to the point of eliminating some Chinese character database items and just retaining the corresponding "marker fields." For example, after eliminating the Chinese character database item "province" in the database, we could save five-sixths of the memory originally used.

2. Appropriate Optimization When in Hierarchical Structure

At the time of the overall designing, the design of some commonly used function module was shared, and this reduced the number of modules and the memory occupied by the program region. For example, the two search modes (power plant and substation) share one module for searching the database, and all three search modes share one module for displaying data and printing data. The display and print module which is at the lowest layer of the hierarchical structure is designed for use with the ZD-2043 12-inch CRT and the ZD-2022 24-pin printer, but if other display terminals and printers are used in the future, it is only necessary to revise these two modules and the other modules need not be changed.

3. Adoption of Monolayer Consecutive Query Mode To Reduce the Number of Layers

The traditional method is the hierarchical query mode: each layer queries once. The disadvantage of this method is that there are too many layers, the number of program modules is also increased. To overcome this shortcoming, this software package changes a number of tree data structure with fewer branches from hierarchical query mode to monolayer consecutive query mode to reduce the original nine layers to seven layers. For example, when searching high tension switches by equipment name mode, the traditional method divides it into four layers; the first layer query is whether it is controlled directly by the general dispatch office, the second layer query is whether it is subordinate to the electric power control bureau or is owned by a factory or enterprise, the third layer query is whether it is installed in a power plant or a substation. The fourth layer query is what

province it is in. We have now combined the first two layers and the last two layers into one layer respectively, that is, the consecutive query is twice in one layer to form individual branching. Although this takes more time when coding, it cuts out two layers and the corresponding number of modules and economizes on memory.

4. Setting Up Auxiliary Databases

Two auxiliary databases were set up outside the main database to save on memory in the data region or for ease of computing generator and power plant rated capacity. Take high tension lines, for example. The length of each transmission line is a very important parameter. However, such parameters as for generator, phase modulator, transformer, boiler, turbine, and high tension switch, do not exist. Thus, if the transmission line parameters are also stored in the main database, the memory which would be taken up by the overwhelming majority of "length" parameters would be wasted, because the number of transmission line data entries would only take up about 10 percent of the number of general database entries. Setting up an independent database for transmission lines would not have any impact on the sharing of data, because transmission lines are not included in power plant and substation equipment.

V. Conclusion

This software package uses a totally hierarchical modularized structure, it is highly reliable, can greatly reduce debugging time, and it is very convenient to revise or expand functions. For the convenience of the user, by carrying out multi-layer and detailed classification of the data in the Chinese character database, the user can very quickly obtain the data and information required. Display of data and information is changed from traditional rolling mode to automatic page mode to facilitate reading by the user. Because Chinese characters and user dialogue are used throughout and it [the database] has a certain "intelligence," it is well suited to an "end user" use and even a person who does not understand computers can learn to use it in 1 or 2 minutes. A security function has been added in answer to user demands.

The marker field method which we created resolved a key problem in making Chinese character microcomputer databases practical so that search speed is greatly increased, and we also adopted a series of measures, such as monolayer consecutive query mode which save a great deal of the memory occupied (altogether approximately 30 percent) by the program region and the data region.

The methods used in this software package are universal and not only can extend to the use of the three-level dispatch bureaus (general dispatch office, provincial dispatch office and regional dispatch office) in electric power systems nationwide, but also have value for general extension to other areas. The author hopes that this article will play a definite positive role in accelerating the practical application of Chinese character microcomputer databases and their broad use.

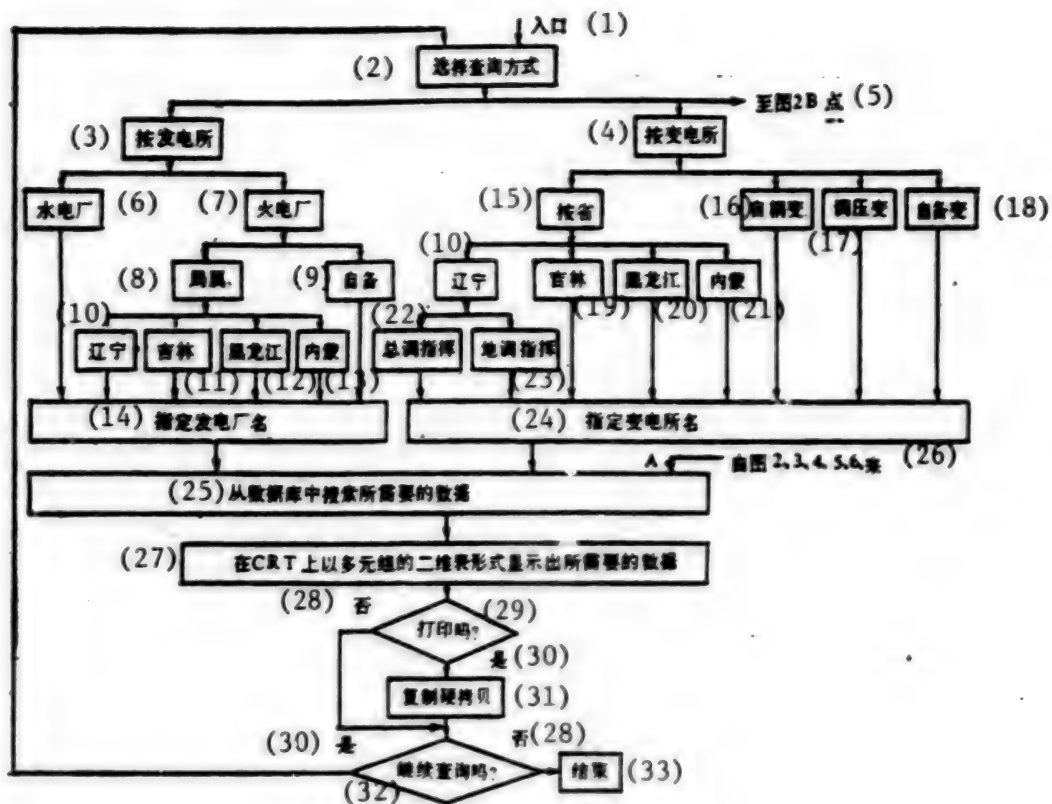


Figure 1

Key:

- | | |
|-------------------------------|-----------------------------------|
| 1. Entry | 19. Jilin |
| 2. Select search mode | 20. Heilongjiang |
| 3. By power plant | 21. Neimeng |
| 4. By substation | 22. General dispatch control |
| 5. Go to Figure 2, B | 23. Local dispatch control |
| 6. Hydroelectric plant | 24. Name of designated substation |
| 7. Thermoelectric plant | 25. Data needed found in database |
| 8. Bureau | 26. From Figures 2, 3, 4, 5, 6 |
| 9. Self-supply | 27. Needed data displayed on CRT |
| 10. Liaoning | in multigroup two dimension |
| 11. Jilin | table |
| 12. Heilongjiang | 28. No |
| 13. Neimeng | 29. Print? |
| 14. Name of indicated power | 30. Yes |
| plant | 31. Make hard copy |
| 15. By province | 32. Continue search? |
| 16. Self-coupling transformer | 33. End |
| 17. Voltage regulator trans- | |
| former | |
| 18. Self-supply transformer | |

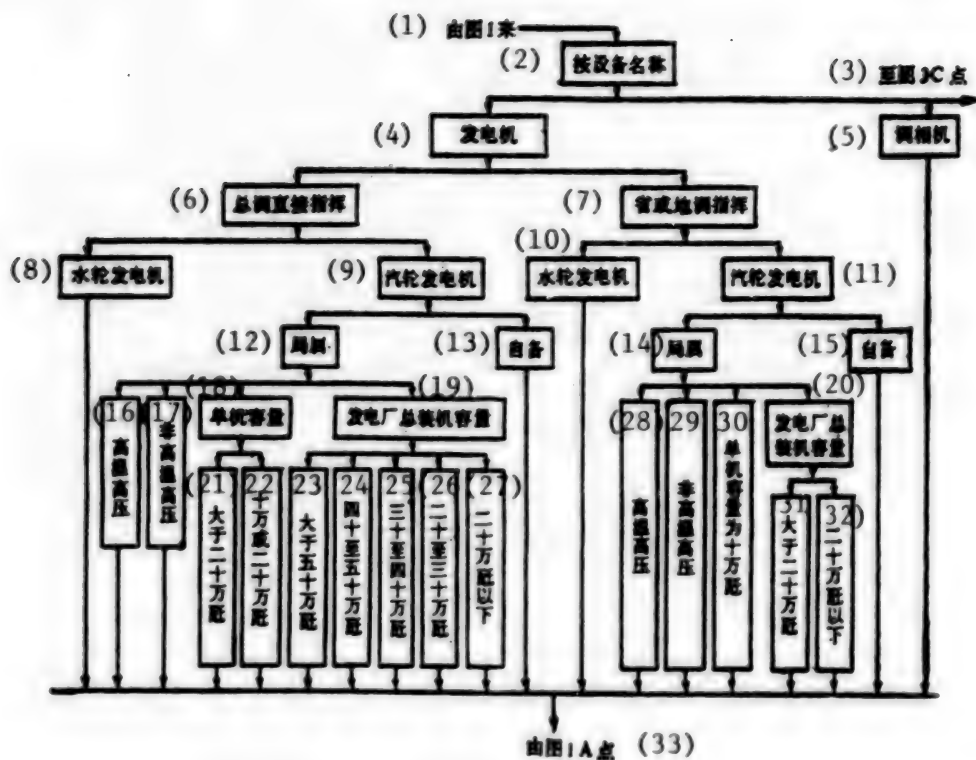


Figure 2

Key:

- | | |
|--|---|
| 1. From Figure 1 | 18. Single generator capacity |
| 2. By name of equipment | 19. Overall rated capacity of power plant |
| 3. Go to Figure 3, C | 20. Overall rated capacity of power plant |
| 4. Generator | 21. Greater than 200,000 kw |
| 5. Phase modulator | 22. 100,000 or 200,000 kw |
| 6. Direct general dispatch control | 23. Greater than 500,000 kw |
| 7. Province or local dispatch control | 24. 400,000-500,000 kw |
| 8. Water-wheel type generator | 25. 300,000-400,000 kw |
| 9. Steam turbine generator | 26. 200,000-300,000 kw |
| 10. Water-wheel type generator | 27. Under 200,000 kw |
| 11. Steam turbine generator | 28. High-temperature high-pressure |
| 12. Under the Bureau | 29. Not high-temperature high-pressure |
| 13. Self-supplying | 30. Single capacitor of 100,000 kw |
| 14. Subordinate to Bureau | 31. Greater than 200,000 kw |
| 15. Self-supplying | 32. Under 200,000 kw |
| 16. High-temperature high-pressure | 33. From Figure 1, point A |
| 17. Not high-temperature high-pressure | |

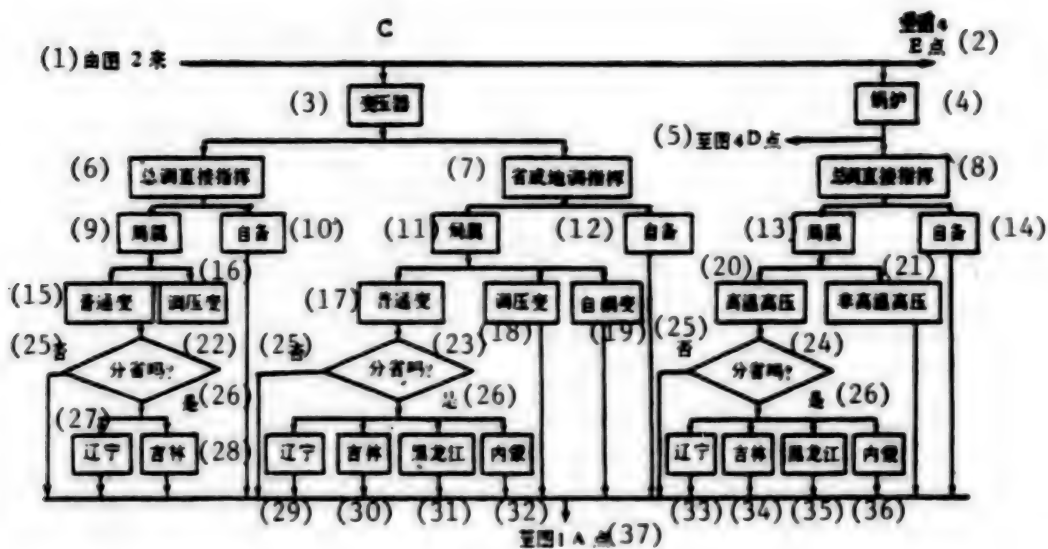


Figure 3

Key:

- | | |
|---|--|
| 1. From Figure 2 | 19. Self-coupling transformers |
| 2. To Figure 4, E | 20. High-temperature high-pressure |
| 3. Transformers | 21. Not high-temperature high-pressure |
| 4. Boilers | 22. Separate by province? |
| 5. To Figure 4, D | 23. Separate by province? |
| 6. Directly controlled by general dispatch | 24. Separate by province? |
| 7. Controlled by province or local dispatch | 25. No |
| 8. Directly controlled by general dispatch | 26. Yes |
| 9. Subordinate to Bureau | 27. Liaoning |
| 10. Self-supplying | 28. Jilin |
| 11. Subordinate to Bureau | 29. Liaoning |
| 12. Self-supplying | 30. Jilin |
| 13. Subordinate to Bureau | 31. Heilongjiang |
| 14. Self-supplying | 32. Neimeng |
| 15. Ordinary transformer | 33. Liaoning |
| 16. Regulating transformers | 34. Jilin |
| 17. Ordinary transformers | 35. Heilongjiang |
| 18. Regulating transformers | 36. Neimeng (Inner Mongolia) |
| | 37. To Figure 1, point A |

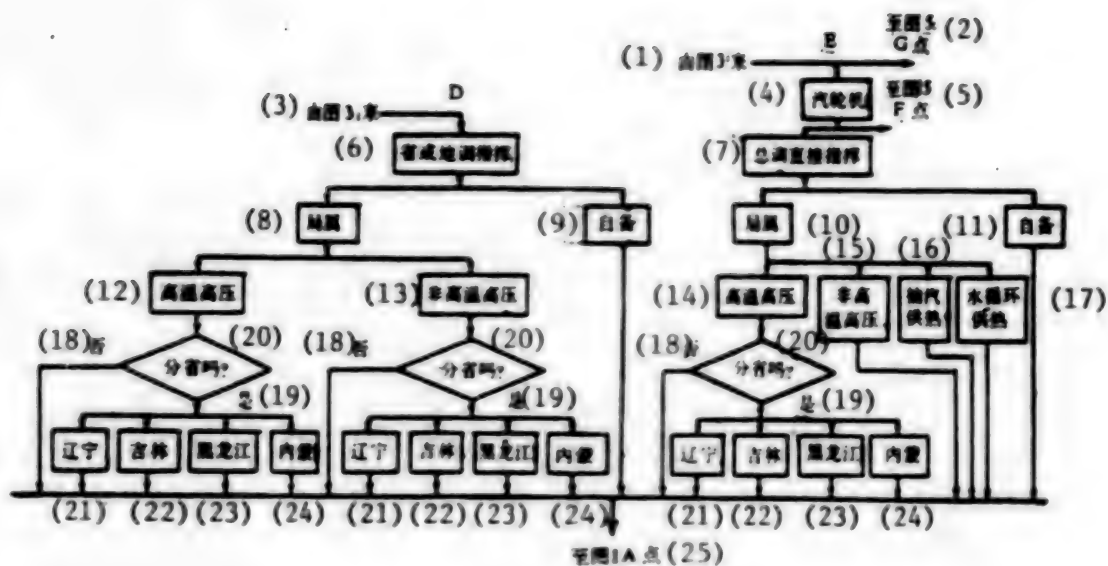


Figure 4

Key:

- | | |
|---|--|
| 1. From Figure 3 | 14. High-temperature high-pressure |
| 2. To Figure 5, G | 15. Not high-temperature high-pressure |
| 3. From Figure 3 | 16. Bleeder heat supply |
| 4. Steam turbine | 17. Water-circulating heat supply |
| 5. To Figure 5, F | 18. No |
| 6. Controlled by province or local dispatch | 19. Yes |
| 7. Directly controlled by general dispatch | 20. Separate by province? |
| 8. Subordinate to Bureau | 21. Liaoning |
| 9. Self-supplying | 22. Jilin |
| 10. Subordinate to Bureau | 23. Heilongjiang |
| 11. Self-supplying | 24. Neimeng |
| 12. High-temperature high-pressure | 25. To Figure 1, point A |
| 13. Not high-temperature high-pressure | |

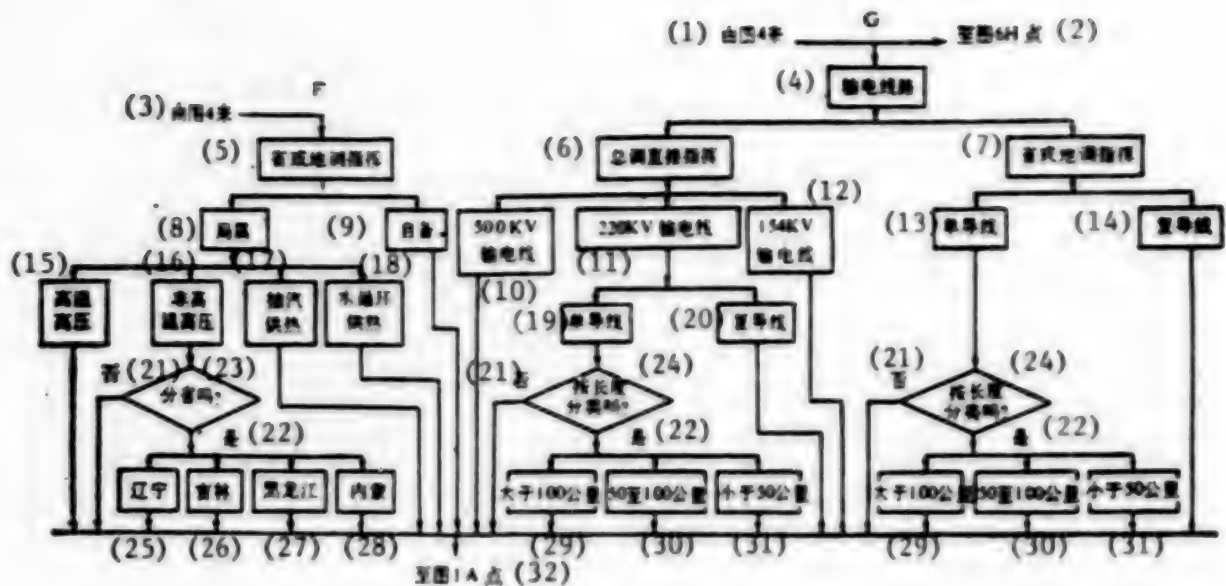


Figure 5

Key:

- | | |
|---|--|
| 1. From Figure 4 | 16. Not high-temperature high-pressure |
| 2. To Figure 6, H | 17. Bleeder heat supply |
| 3. From Figure 4 | 18. Water circulation heat supply |
| 4. Transmission lines | 19. Single lines |
| 5. Controlled by province or local dispatch | 20. Multiple lines |
| 6. Directly controlled by general dispatch | 21. No |
| 7. Controlled by province or local dispatch | 22. Yes |
| 8. Subordinate to Bureau | 23. Separate by province? |
| 9. Self-supply | 24. Classify by length? |
| 10. 500KV transmission lines | 25. Liaoning |
| 11. 220KV transmission lines | 26. Jilin |
| 12. 154KV transmission lines | 27. Heilongjiang |
| 13. Single lines | 28. Neimeng |
| 14. Multiple lines | 29. > 100 km |
| 15. High-temperature high-pressure | 30. 50 to 100 km |
| | 31. < 50 km |
| | 32. To Figure 1, point A |

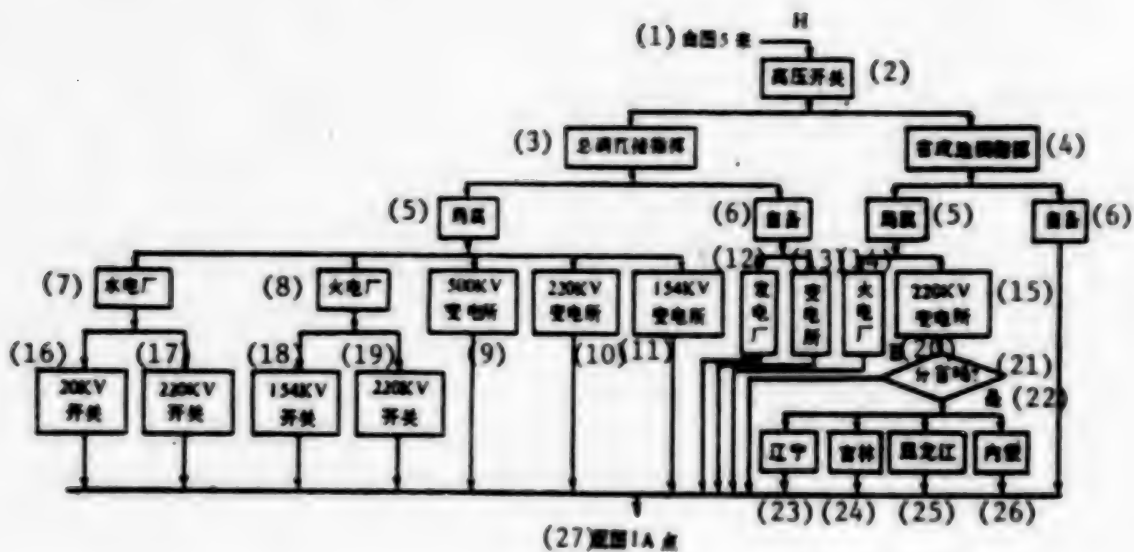


Figure 6

Key:

- | | |
|---|------------------------------|
| 1. From Figure 5 | 14. Thermal power plant |
| 2. High-pressure switch | 15. 220KV substation |
| 3. Directly controlled by general dispatch | 16. 20KV switch |
| 4. Controlled by provincial or local dispatch | 17. 220KV switch |
| 5. Subordinate to Bureau | 18. 154KV switch |
| 6. Self-supply | 19. 220KV switch |
| 7. Hydroelectric plant | 20. No |
| 8. Thermoelectric plant | 21. Separate by province? |
| 9. 500KV substation | 22. Yes |
| 10. 220KV substation | 23. Liaoning |
| 11. 154KV substation | 24. Jilin |
| 12. Power plant | 25. Heilongjiang |
| 13. Substation | 26. Neimeng (Inner Mongolia) |
| | 27. To Figure 1, point A |

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CSO: 4008/1033

APPLIED SCIENCES

STEAM-WATER SEPARATOR FOR QINSHAN PWR PLANT DESCRIBED

Chengdu HE DONGLI GONGCHENG [NUCLEAR POWER ENGINEERING] in Chinese Vol 7, No 1, Feb 86, pp 20-23, 39

[Article by Shen Changfa [3088 7022 4099], Chen Xinggen [7115 2622 2704], and Chen Baozhen [7115 1405 3791]: "The Development of Steam-Water Separating Equipment for Qinshan PWR Plant Steam Generators"]

[Text] Abstract: This paper describes the air-water screening tests at low pressure and the steam-water qualification test at hot condition for steam-water separating equipment of the steam generations of Qinshan PWR plant. The structure of the separating-drying system is also introduced simply. The overall behavior test of the steam-water separating equipment shows that the steam moisture at the drier exit is far less than the specified amount of 0.25 percent.

1. Introduction

Steam-water separating equipment--separators and dryers--are important components for purifying the steam in a steam generator. The characteristics of the separating equipment not only affect the dimension of the upper cylinder, the circulation and stability level of the water, but may also affect the normal operation of the steam turbine. Incidents have occurred abroad in which improper design and subsequent failure of the separator parts have caused reactor shutdown. The steam-water separator must therefore be designed carefully. Since China has had no experience in designing large-scale steam-water separators to be used in the Qinshan nuclear power plant steam generator, and the separator structure and the two phase flow in the separator are rather complex, the current design must be tested before finalized.

The research and development of the steam-water separator for the Qinshan nuclear power plant began in 1974, aimed at determining the actual structure of the separators and obtaining the separation performance and operation characteristics. The effort was divided into two stages. In the first stage (1974-1976), the cold test components of the separators were designed. The design was made to meet the requirements of the Qinshan steam generator and was based on the accumulated engineering experience of the designers and sparse data published in foreign journals. Two air-water simulation tests were made in August 1975 and February 1976 and the separator structures were tentatively determined.

In the second stage, large scale hot state evaluations were made on a specially built steam-water semi-industrial test bed with the separators laid out according to the actual arrangement in the steam generator and the tests were made under working parameters and operating conditions close to that of a steam generator. The structure and operating characteristics of the various separator stages for the Qinshan steam generator were then finalized to serve as a reliable basis for construction design.

II. Determination of the Steam-Water Separation Stage

When the Qinshan plant steam generator was designed, very little reference data were available and the structure and operation characteristics of the band hook corrugated plate dryer were not well understood. In order to ease the work load of developing our own steam dryer, to decrease the steam humidity at the inlet and prevent premature failure of the first stage separator, a separation stage was added after the propeller separator and the steam-water separating device was made into a three-stage separator. This was an action necessitated by the particular set of circumstances at the time, experience showed that it was a necessary and correct action.

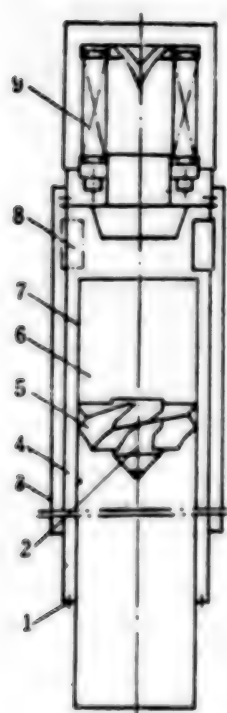
The three-stage separator was distinctly different from the two-stage Westinghouse, Framatome, and KWU steam generator. W.R. Carson and others of the CE Company believed that the steam humidity at the outlet of the large diameter first stage separator of the Westinghouse was too high and required a high performance dryer. They also pointed out that the Westinghouse model was not suitable for further development¹. In order to reduce the humidity at the outlet of the first separator, the Framatome 55/198 model steam generator had a 231mm tall augmental "blocking ring" installed in the first generator. In its newly designed 73/19 model, an axial output second separator was officially incorporated. The three-separator design concept of the Qinshan steam generator was therefore in line with the new direction in China and abroad.

III. Structural Design of the First Separator

The design of the Qinshan steam generator calls for a close pack of 53 small diameter (130mm) propeller separators as the first stage separation elements. This design is drastically different from the sparse array of large diameter (1300mm) separators as in the Westinghouse and Framatome models. The small diameter cylinders can be packed more closely and more can be packed into the upper cylinder body and thereby reducing the design throughput of each separator. Also, the small diameter separators require a smaller steam source and a smaller frame, which makes the hot state testing easier.

The advantages of the propeller separator are the greater load limit, the easier and tighter layout, the greater allowable water level excursion, and the higher stability of the water level in the steam generator during operation. To determine the specific structure of the separator, a series of tests were made on the gas-water test bed for the propeller blades (flat blades and inlet guide curved blades), the diameter d of the central cylinder, the steam water phase separation height, disengagement height h , and the tangential water outlet. The final design, shown in Fig. 1, is a propeller separator with an inlet guide.

It consists of four flat propeller blades welded onto the central cylinder, an ascent barrel, a descent barrel, a blocker, a water outlet hole plate and a tangential water outlet. The steam-water mixture flows through the propeller and changes its linear motion to a rotational mode. Under the action of the centripetal force, a central stream flow surrounded by a rotating tube of water layer are formed in the space between the blade outlet and the inner cylinder outlet. Most of the extracted water flows down along the wall, passes through the outlet hole, and drains into the eater space. The rest of the water is expelled through the tangential outlets. After the first stage dehumidification, the steam enters the second stage separator through the blocking barrier for further separation of the steam and water.



Key:

1. Water discharge hole plate
2. Central barrel
3. Water discharge tube
4. Descending barrel
5. Inlet guiding flat blade
6. Primary separator
7. Ascending barrel
8. Tangential water discharge hole
9. Secondary separator

Figure 1. First and second stage separators

IV. Structural Design of the Second Stage Separator

The performance of four types of second separators was compared. These were the cone separator, the steel wire mesh separator, the band hook corrugated plate separator, and the radial blade separator. The performance of the radial blade separator was found to be the poorest. The steel wire mesh separator performed well, slightly better than the corrugated plate separator. The wire mesh separator works like a filter and may suffer from blockage and wire breakage after long periods of operation, resulting in malfunction and a lowered inlet flow speed. It was therefore decided that the corrugated plate separator with an axial output (shown in Fig. 1) be chosen.

V. Structural Design of the Dryer

The function of the dryer is to remove the small water droplets and mist from the steam and reduce the humidity of the steam to the design target of 0.25 percent or less.

The steam generator of the Qinshan power plant has a large circulation ratio and demands a high work load of the first separators. The dryer must therefore have good performance under high input humidity and flow rate. After comparing the cone separator, the upright corrugated plate separator, and the band hook corrugated plate separator, a choice was made to use a band hook corrugated plate separator with a double layer quadrilateral layout. This separator was developed on the basis of the upright corrugated plate separator and has been successfully used as dryers in foreign nuclear power plant steam generators.

The waveform, wavelength, hook spacing, plate separation and water drainage structure of the separator were determined in cold tests. A hot test unit, shown in Fig. 2, was designed. It consisted of upper and lower blades, upper and lower support frames, steam equalizing hole plate and a water drainage tube. After the steam was dehumidified twice and separated gravitationally, the steam entered the upper and lower blade assemblies in parallel, constantly changing direction as it flowed along the zigzagging channel and losing the water droplets to the wall surface to form a film of water. The water catching hooks at the top of the corrugated plate served to collect the flow of water along the plate surface and the droplets in the steam flow. The collected water flowed along the narrow channel formed by the corrugated plate and the water blocking hooks and was drained into the water tank at the bottom.

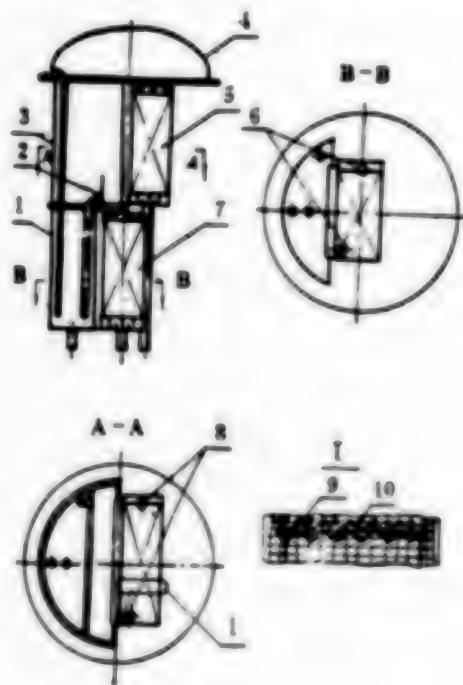


Figure 2. Hot test dryer design

[Key on following page]

Key:

- | | |
|--------------------------------|-------------------------|
| 1. Lower support frame | 6. Drainage tube |
| 2. Water collecting trough | 7. Lower blade assembly |
| 3. Upper support frame | 8. Drainage tube |
| 4. Steam equalizing hole plate | 9. Water blocking hook |
| 5. Upper blade assembly | 10. Corrugated plate |

VI. Overall Performance of the Separator-Dryer

Tests are performed to simulate the splash caused by the extracted water from the tangential outlet hitting the cylinder wall and to simulate the collision of steam-water flows from the second separator. Based on the steam source capacity of the steam-water test bed, hot tests were performed with three prototype first and second separators and a double layered corrugated plate dryer with a single side steam inlet in the experimental setup (Fig. 3).

The test curve shown in Fig 4 shows that, for circulation ratios of 4 or 5, the steam-water separation system was not sensitive to the variation of the steam generator load. The steam humidity at the outlet of the dryer showed almost no change before full load and the humidity was only 0.01 percent. Before 100 percent load, the output humidity slowly increased. The output steam humidity was still only 0.034 percent when the load was 134 percent, the output humidity of the first and second separator was 32 percent, and the dryer inlet steam velocity was 1.33 m/s. The results showed that the design of the separator and the dryer was a success and the overall performance was good. These test results have been applied in the construction design of the steam water separator of the steam generator at the Qinshan nuclear power plant.

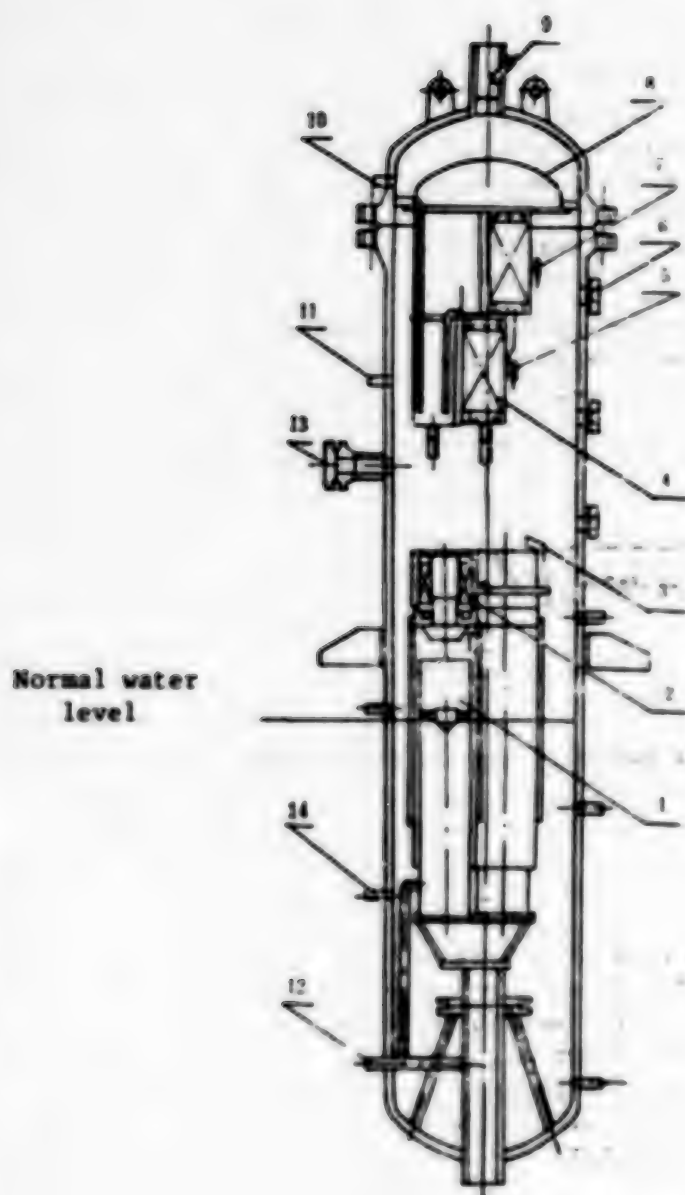


Figure 3. Experimental test system

Key:

- | | |
|---|----------------------------------|
| 1. First separator | 6. Observation window |
| 2. Second separator | 7. Upper plate of dryer |
| 3. Sampling for second separator output | 8. Steam equalization hole plate |
| 4. Dryer | 9. Output sampling |
| 5. Sampling before lower plate of dryer | 10. Resistance test point #1 |
| | 11. Resistance test point #2 |
| | 12. Resistance test point #3 |
| | 13. [Omitted] |
| | 14. Sampling of furnace water |

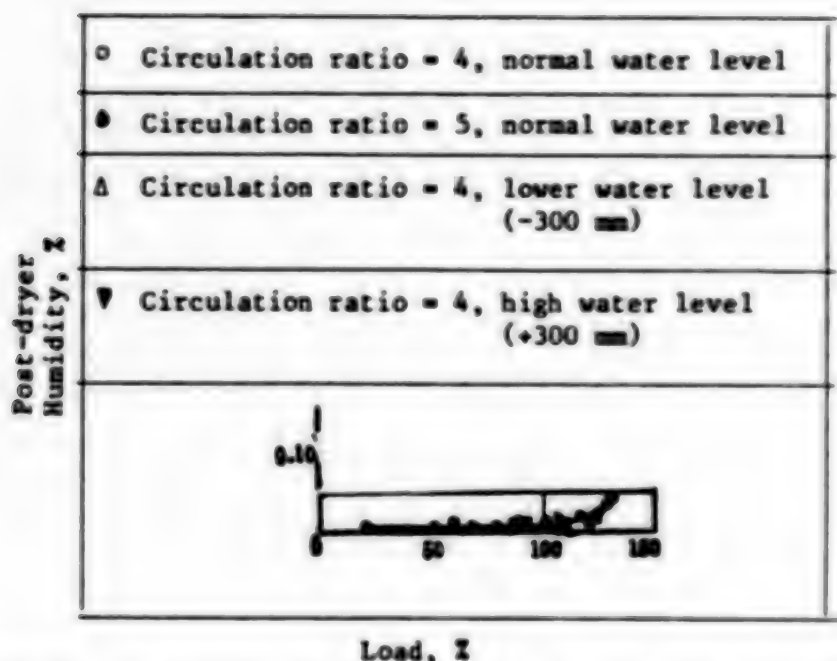


Figure 4. Relationship between post-dryer humidity and load under different operating conditions

VII. Conclusion

(1) The humidity of the steam output was less than 0.04 percent in the steam-water separation system consisting of guided inlet flow propeller separators and a corrugated plate dryer with a double layer and an axial steam output. The humidity remained less than 0.04 percent under all operating conditions the system may encounter (a steam load of 20-134 percent, a water level fluctuation of ± 300 mm, and a circulation ratio of 4 or 5). This humidity met the requirement of less than or equal to 0.25 percent.

(2) The first double layer corrugated plate dryer developed in China showed good dehumidification performance. The output steam humidity remained less than 0.06 percent for an input steam humidity ≤ 29 percent and an inlet steam flow velocity ≤ 1.34 m/s.

9698/12766

CSO: 4008/57

LIFE SCIENCES

TREATMENT OF ADVANCED BURN CASES

Beijing CHINESE MEDICAL JOURNAL in English Vol 99, No 3, Mar 86 pp 187-190

[Article by Guan Wenxiang [7070 2429 4382], Qian Yunliang [6929 0061 5328], Cheng Kaixiang [4453 7030 4382], and Xu Ligen [6079 4409 2704] of the Department of Plastic and Reconstructive Surgery, Ninth People's Hospital, Shanghai Second Medical College, Shanghai: "Free Medial Thigh Flap in Treatment of Advanced Burn Cases"]

[Text]

The free medial thigh flap, first reported by Baek in March 1983, is supplied by an unnamed artery arising from the medial side of the superficial femoral artery. We have successfully used this in 6 burned cases and found that there are some anatomical differences between Baek's findings and ours. We consider that the medial thigh flap has more advantages than disadvantages, and a much greater flap could be designed if one is not attempting to close the donor wound merely by approximation.

In 1983, Baek¹ first reported the use of free medial thigh flap. He had dissected . . . sides of 25 cadavers and conducted 50 clinical angiographic studies of the femoral arteries before he introduced the free flap to his clinical cases. From the study of the cadavers, he found that the unnamed artery was present in all cadavers and the artery arose from the superficial femoral artery at nearly the same level, i.e. just proximal to the adductor canal from the medial side of the superficial femoral artery.

Guided by Baek's experiences, we have, since June 1983, applied the free medial thigh flap in 6 advanced cases of burns, of which 5 were scar contracture on the hand and one was depressed unstable scar over the pretibial region. All the 6 cases except one, in which only 60% of the flap survived due to unfavorable condition of the recipient vein, achieved a 100% survival rate of the flap. As for anatomical details, some slight difference exists between Dr Baek's findings and ours.

REPORT OF SIX CASES

Case 1. A 47-year-old male sustained a flame burn (10% second to third degree burn) on hands and face in June 1981, resulting in scar contracture around the left thenar region, which considerably interfered with the left thumb motion.

On June 21, 1983, under epidural anesthesia, the scar over the thenar region was excised and a medial thigh flap measuring 10×8 cm was raised from his right thigh. The unnamed artery was 1.2 mm in diameter and 2 cm long, originating from the superficial femoral artery at a point of 4 cm distal to the entrance of the adductor canal. For the venous return, the vena comitans was discarded and the greater saphenous vein was purposely chosen as its caliber was large enough to ensure success of this first case.

The flap was transferred to the wound on the hand and vascular anastomosis was performed between the unnamed artery and the carpal branch of the radial artery and also between the greater saphenous vein and the cephalic vein.

The flap survived completely and stitches were removed on the tenth postoperative day. The thumb can move freely now.

Case 2. A Male of 26 years old sustained a flame burn of 32.5% of his body surface in May 1978, mainly involving his face and two hands. Later, he developed first web space scar contracture of his left hand and also dorsiflexion deformity of the left thumb metacarpophalangeal (MP) joint.

On July 16, 1983, under brachial block and continuous epidural anesthesia, the left first web space was opened up and dorsiflexion deformity of the left thumb MP joint corrected as well by excising the responsible scar, leaving a wound of about 6×8 cm on the left hand.

A medial thigh flap, measuring 7×9 cm was prepared on his right thigh, based on the unnamed artery (1 mm in diameter and 3-4 cm long) arising from the superficial femoral artery at a point of 4 cm distal to the entrance of the adductor canal. The greater saphenous vein was chosen for the venous drainage of the flap as the vena comitans was too tiny (about 0.2 mm in diameter) for vascular anastomosis.

The medial thigh flap was transferred to cover the wound on his left hand and revascularization was established by anastomosing the unnamed artery to the carpal branch of the radial artery and greater saphenous vein to the cephalic vein of the left hand.

On the second day of the operation, the flap appeared cyanotic and immediate exploration was undertaken. Inadequate venous drainage of the flap was found due to impaired recipient cephalic vein and therefore a local but more intact vein (6 cm long) was chosen for substitution. Good blood flow was immediately restored and cyanosis gradually disappeared. Therefore, a complete take of the flap was achieved and stitches were removed on the tenth postoperative day.

Case 3. A male of 33 years old sustained a flame burn on his right hand in April 1983, resulting in scar contracture over the thenar region and the first web space with restricted thumb motion.

On September 13, 1983, under epidural anesthesia, the responsible scar over the thenar region was excised and the first web space reopened to sufficiently wide, leaving a wound of 10×6 cm on the hand.

A medial thigh flap measuring 11×7 cm was prepared on his left thigh. The unnamed artery was 1.2 mm in diameter and 3 cm long, and the vena comitans 1.5 mm in diameter. The former arose from the superficial femoral artery at a point of 6 cm distal to the entrance of the adductor canal.

The flap was transferred to the wound on the hand and reanastomosis of the vessels was done between the unnamed artery and the carpal branch of the radial artery and also between the vena comitans and the cephalic vein of the hand.

The flap survived completely and stitches were removed on the tenth postoperative day. Functional restoration of the hand was good.

Case 4 (Figs 1-5). A male of 22 years old sustained a burn on both hands, resulting in scar contracture of the first web space of his right hand associated with dorsiflexion deformity of the thumb MP joint.

On September 27, 1983, under epidural anesthesia, the dorsiflexion deformity of the thumb MP joint was corrected and the first web space was opened wide by excising the scar.

A medial thigh flap, 10×8 cm in area, was raised from the left thigh, with vascular pedicle composed of the unnamed artery (1.2 mm in diameter) and the vena comitans (1.2 mm in diameter). The unnamed artery left the femoral trunk at a point

about 1 cm distal to the entrance of the adductor canal and then divided into three tiny branches after travelling for a distance of 1 cm.

After transferring of the flap, revascularization was done between the unnamed artery and the carpal branch of the radial artery and also between the vena comitans and the cephalic vein.

The flap survived completely and stitches were removed on the tenth postoperative day. The thumb motion was mostly restored.

Case 5. A male of 20 years old sustained a burn (12% second to third degree burn) over the right distal forearm, the face, and the neck. The wound on the forearm was infected and was later skin-grafted in a local hospital after infection had subsided. On admission, physical examination revealed dense fibrous adhesion between the skin graft and the underlying tendons. Besides, the right wrist was fixed in palmar flexion position by the contracted skin graft. No pulsation was felt along the distal portion of the radial artery.

On October 5 1983, under epidural anesthesia, the scar over the right distal forearm was excised, incorporated with releasing of the involved tendons.

A medial thigh flap measuring 12×7.5 cm was raised from the right thigh, with the unnamed artery (1.2 mm in diameter and 3 cm in length) and the vena comitans (1.5 mm in diameter) as the vascular pedicle. The unnamed artery arose from the superficial femoral artery at a point of 5 cm distal to the entrance of the adductor canal.

The flap was transferred to the forearm wound and revascularized by anastomosing the unnamed artery to the carpal branch of the radial artery and the vena comitans to the cephalic vein of the hand.

As the carpal branch of the radial artery was not in good condition and received retrograde blood flow from the palmar arterial arch, circulatory embarrassment occurred on the second postoperative day, which led to partial loss (40%) of the flap, mostly at its periphery. The residual wound was successfully covered with a skin graft after growth of granulation.

Case 6 (Figs 6-9). A male of 21 years old sustained 18% of second to third degree burn on his both legs in December 1981, resulting in amputation of his left leg and an unstable depression scar (10×5 cm in area) on the pretibial region of his right leg. The patient complained of repeated tissue breakdown of the site.

On November 16, 1983, under epidural anesthesia, a medial thigh flap measuring 12×7 cm was developed on the right thigh, with the unnamed artery (1.2 mm in diameter and 2.5 cm in length) and the vena comitans (1.5 mm in diameter) as the vascular pedicle. The unnamed artery originated from the superficial femoral artery at a point of 2 cm distal from the entrance of the adductor canal.

After transferring the flap, vascular anastomosis was done between the unnamed artery and the anterior tibial artery in an end-to-side fashion, and also the vena comitans of the unnamed artery to the vena

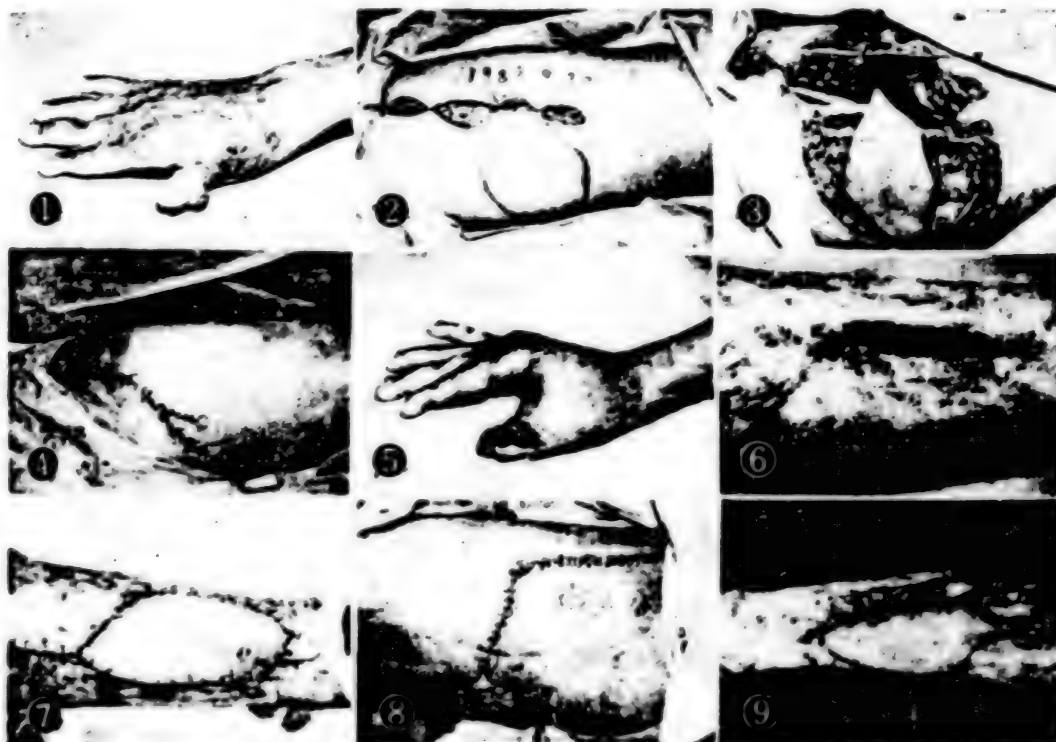


Fig 1. Case 4, preoperative view. Hyperextension of thumb MP joint and narrow first web space due to scar contraction.

Fig 2. Case 4, outline of the medial thigh flap.

Fig 3. Case 4, the medial thigh flap is dissected out but vascular pedicle still attached to the thigh.

Fig 4. Case 4, the donor wound is closed by approximation.

Fig 5. Case 4, two weeks after operation.

Fig 6. Case 6, preoperative view. An unstable depressed scar over the pretibial region.

Fig 7. Case 6, the medial thigh flap is transferred to the pretibial region.

Fig 8. Case 6, the donor wound is approximated.

Fig 9. Case 6, six weeks after operation.

comitans (2 mm in diameter) of the anterior tibial artery.

In this case, the unnamed artery travelled for a short distance and then was divided into several tiny branches which surrounded the greater saphenous vein. In order to preserve these tiny branches to the skin flap, the greater saphenous vein had to be divided temporarily and pulled out from the network of these tiny branches and then reconnected underneath them.

The postoperative course was unevenful and the flap survived completely. Stitches were removed on the 12th postoperative day.

DISCUSSION

Microsurgery has brought a new era to the plastic and reconstructive surgery by reducing

the conventional multistaged-procedure to a single-staged one and also by eliminating the most uncomfortable postural immobilization which the patients usually have to endure for at least three weeks at each stage. These superiorities have inspired plastic surgeons as well as surgeons in other fields to search for newer flaps which have fewer shortcomings than the old ones. But not every flap could entertain long popularity unless it satisfies the following four requirements: the flap should be thin enough to meet the usual cosmetic requirements; it must be of considerable size to cover the usually large defect; the flap vessels must have adequate length and reasonably large caliber to ensure success of transfer; and no functional or cosmetic problems be imposed upon the donor site.

We consider that the medial thigh flap virtually has advantages compatible with the aforementioned requirements, and so could be regarded as a promising flap. From our 6 cases, we would like to add three points which we hope might be of help to those who are interested in trying this new flap.

According to our experience, the axis of the flap usually is more transversely located in our cases than that shown by Baek. Therefore, in order to design the flap in the proper direction to ensure more blood supply to the flap, we routinely dissect out the unnamed artery and confirm its course first, and then readjust the outline of the flap to take in as much as possible the blood flow the unnamed artery could provide.

In order to make the dissection easier and hence shorten the operating time, it is advisable to begin with that portion of the superficial femoral artery whose pulsation could be easily felt in the upper thigh. The superficial femoral artery is exposed there by splitting its sheath and

traced downwards until an adequately-sized medial branch is reached. This arterial branch or rather the unnamed artery could be situated at the upper part, the middle part or even the lower part of the adductor canal. With this anatomical feature kept in mind, one is less likely to miss it or injure it.

The largest flap used in our cases was 12×7.5 cm, a little larger than that used by Baek (12×6 cm). But it deserves mentioning here that this is not the uppermost limit of the flap which could be developed in this region. On the contrary, this size is only determined by the patient's need and we consider that a much greater flap could be designed here if one is not attempting to close the donor wound merely by direct approximation.

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CS0: 4010/1056

LIFE SCIENCES

SKIN FLAP TRANSPLANTATION PROCEDURE DISCUSSED

Beijing CHINESE MEDICAL JOURNAL in English Vol 99, No 3, Mar 86 pp 225-228

[Article by Yu Zhongjia [0060 0112 0857] and He Hegao [0149 7729 4108] of the Orthopedic Department, No 6 People's Hospital, Shanghai: "Combined Bilateral Free Latissimus Dorsi Skin Flap Transplantation--Report of a Case"]

[Text]

The authors creatively performed a combined bilateral free latissimus dorsi myocutaneous flap transplantation for an eight-year-old girl to repair a skin defect measuring 26×18 cm encircling the entire left leg between the knee and foot. Two free latissimus dorsi myocutaneous flaps were joined to form a single flap with only one common vascular pedicle—the right subscapular artery and vein. The left subscapular artery is anastomosed to the right circumflex scapular artery and the left subscapular vein connected with the right circumflex scapular vein. The left circumflex scapular artery and vein being redundant, are ligated. Cross-bridge vascular anastomosis was employed due to the absence of blood vessels available for anastomosis at the recipient site. The flaps survived and the patient can bear weight and walk with the affected leg. There has been no functional impairment of the upper limbs after the removal of both latissimus dorsi myocutaneous flaps.

Satisfactory repair of certain skin and deep soft tissue defects have been achieved since transplantation of vascularized free skin flaps has gradually become a general practice. Free skin flap as large as 40×9 cm has been successfully transplanted in our country.¹ But there still remains the problem of extensive skin and compound soft tissue defects accompanied with lack of appropriate vessels for anastomosis in the recipient area. In 1983, we admitted a patient with extensive circumferential scarring of the left leg from knee to ankle consequent to near-total loss of lower leg skin. This type of tissue defect cannot be repaired in the usual way by transplanting a vascularized free skin

flap. A new operative procedure was therefore specially designed and performed. Bilateral vascularized free latissimus dorsi skin flaps (30×9 cm from the right side and 28×11 cm from the left) were combined into one and transplanted in one stage. The result was gratifying. The case is reported in this paper.

CASE REPORT

The patient, female, aged 8, sustained a serious crush injury of the whole lower left leg extending from the knee to the ankle joint in a car accident in 1980, resulting in very extensive destruction of the skin and soft tissue and fracture of the tibia and fibula. Infection occurred after debridement in a local hospital. A prolonged period of treatment was required to control the infection before the wound finally healed. The leg was badly deformed, with a circumferential scar and deep soft tissue damage involving the blood vessels. There was foot-drop owing to contracture of the tendo calcaneus making walking impossible (Fig 1). To restore normal function, the scar tissue had to be excised, the leg covered with normal skin and the foot-drop corrected. It was difficult to find a free skin flap large enough to cover the defect and the anterior tibial artery and greater and lesser saphenous veins of the left leg were severely traumatized rendering them unfit for anastomosis. We therefore decided to perform combined bilateral free latissimus dorsi skin flap transplantation, using the anterior tibial-dorsal pedal artery and the great saphenous vein of the right leg to establish a cross-bridge type of blood supply. The defect was to be repaired in one stage.

The operation was performed on December 13, 1983 under intravenous anesthesia with endotracheal

intubation. The major steps of the procedure were: excising the latissimus dorsi skin flap of the right and then the left side; total excision of the left leg scar; dissection of the right dorsal pedal-anterior tibial artery and great saphenous vein; combining the 2 latissimus dorsi skin flaps into one large flap; establishment of cross-bridge type blood supply to the recipient area (after crossing the lower extremities) and complete covering and closure of the wounds.

The patient was first placed in the left recumbent position. An incision was made along the line of the previously marked area over the right latissimus dorsi region. After identifying the lateral border of the latissimus dorsi, the thoracodorsal artery and vein were found and isolated, and the circumflex scapular and subscapular vessels freed by retrograde dissection for 3 cm. The latissimus dorsi muscle was then separated from the ribs and the inferior angle of the scapula and cut along the lumbodorsal fascia at the humeral insertion. Branches communicating with the lateral thoracic artery and other perforating vessels were ligated and severed. The whole flap measured 30×9 cm, and was entirely freed except at its vascular pedicle. Active oozing was seen along the cut edges of the flap, signifying adequate blood perfusion. The patient was then changed to the right recumbent position and the new operative area draped and sterilized, with the surgical gowns changed at the same time. A left latissimus dorsi skin flap measuring 28×11 cm was taken, using the same technique as described. Both latissimus dorsi skin flaps were left in situ temporarily.

A 26×18 cm piece of scar tissue was excised from the left leg. Since the muscles of the leg were largely lost, it was impossible to find the anterior tibial-dorsal pedal artery and the greater and lesser saphenous veins. The posterior tibial artery was buried within the degenerated fibrous tissue. As a result, no vessels suitable for anastomosis with those of the free skin flaps were available within and around the entire wound region. The blood supply to the transplanted flaps thus could not be solved in the conventional way.

A sigmoid incision was made on the right foot dorsal ankle region. The dorsal pedal-anterior tibial artery was dissected 10 cm and the great saphenous vein about 11 cm (Fig 2).

The vascular pedicles, i.e., the subscapular vessels of both latissimus dorsi skin flaps were severed near their junctions with the axillary vessels. The resultant length of the subscapular vascular pedicles was approximately 3 cm and that of the circumflex scapular vessels was about 2.5 cm. The stumps of these vessels left in the donor region were all ligated. Both free flaps were transferred to the left leg, the right flap being placed over the posterior surface of the leg and the left over the anterior surface. The lower part of the ankle incision and skin edges of the two latissimus dorsi skin flaps were sutured first, leaving only the parts containing the vascular

pedicles free. To combine the two free flaps into a single unit, the vessels of their vascular pedicles were cross-anastomosed as follows. The right circumflex scapular vein was anastomosed with the left subscapular vein, and the left circumflex scapular vein ligated, preserving only the right subscapular vein; the right circumflex scapular artery was anastomosed with the left subscapular artery, and the left circumflex scapular artery was ligated, preserving the right subscapular artery.

The right hip and knee joints were flexed to about 90 degrees, with slight external rotation of the right lower extremity. The dorsum of the right foot was brought beneath the left leg, forming a 60 degree angle between the two lower extremities. The upper medial edge of the right ankle incision was dissected and elevated to create a pedicle skin flap. This was sutured to the margin of the latissimus dorsi skin flap over the left leg to serve as the base of the skin bridge and a tissue bed for the vascular pedicle. The right great saphenous vein was anastomosed end-to-end with the right subscapular vein, and the right dorsal pedal artery with the right subscapular artery (Fig 3). Upon release of the vascular clamp, however, the veins of the transplanted free flap became greatly engorged with no blood seen returning to the saphenous side of the anastomosis. It was decided to excise the anastomosis and search for the cause. A part of a venous valve was found to have been stitched to the venous wall during the anastomosis. Excision of the segment and re-anastomosis were done, which immediately restored good circulation to the combined free flap. The upper ends of the two free flaps were cross-sutured together and also sutured to the lateral edge of the right ankle incision to form the roof of the skin bridge which was thus completely closed (Fig 4). A length of drain under negative pressure suction was inserted beneath the skin flap.

The skin edges of both regions of the latissimus dorsi skin flaps were sutured directly at the upper and lower ends. The middle portions of the wound surface were covered with medium thick skin grafts of 8×3 cm and 6×5 cm size on the left and right sides.

Both knees and ankles were immobilized including the proximal and distal parts with PP casts to keep the extremities in position and prevent tearing apart of the skin bridge. Fenestrations were made on the anterior aspect of the skin flap and skin bridge to aid observation of the circulation of the flap as well as facilitate dressing changes.

The duration of surgery was 9 hours and 55 minutes. The skin flap ischemic period was 2 hours and 30 minutes.

The patient was kept in a postoperative ward for special nursing. LMD 1,000 ml was given by intravenous drip daily and antibiotics and antispasmodics given intravenously. On the 20th postoperative day, moderate cyanosis was observed on the distal part of the skin flap over the anterior aspect of the leg, this was followed by blister formation.

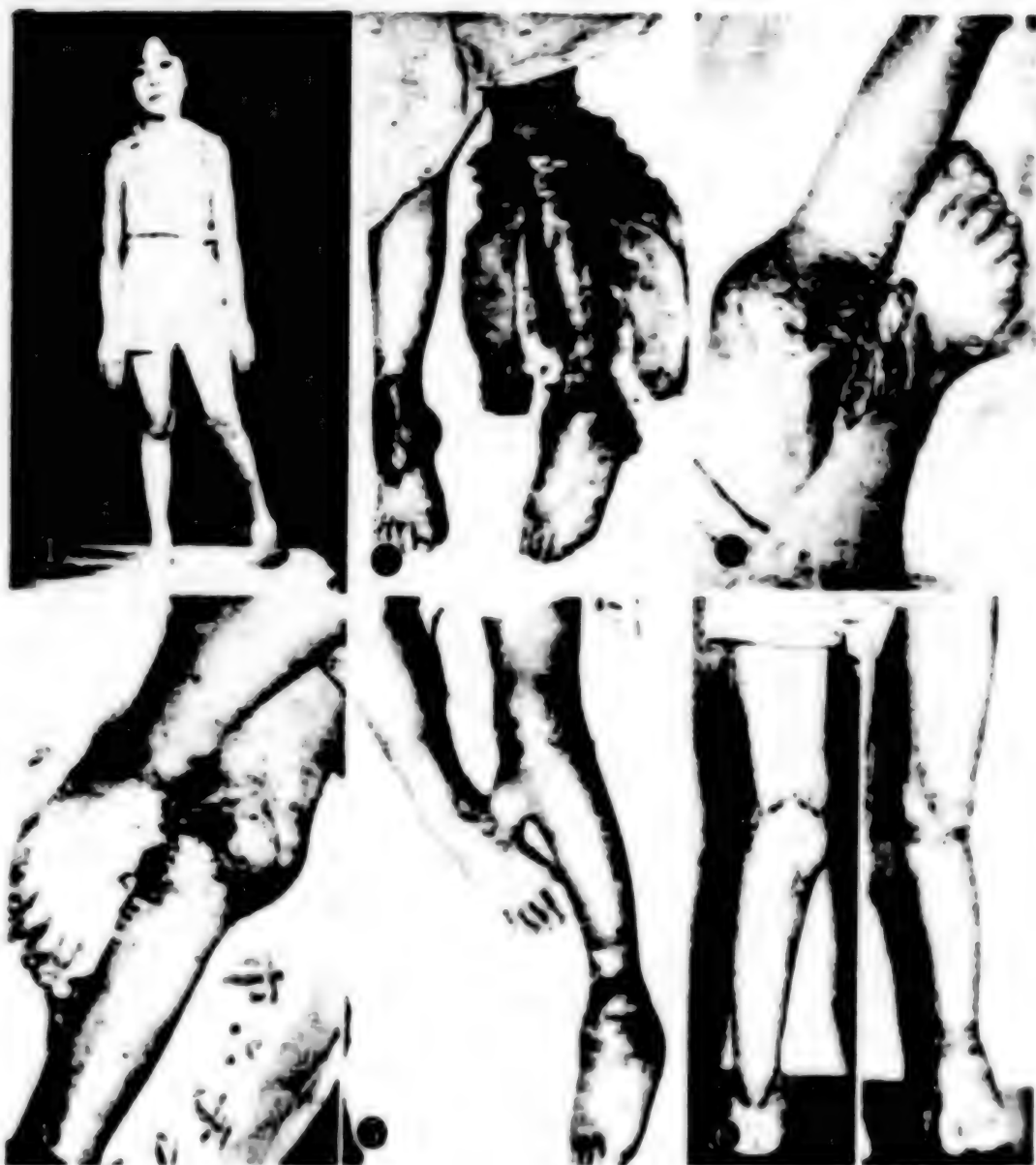


Fig 1. An 8-year-old girl with extensive scar formation encircling her left leg from the knee to the ankle after an automobile accident inflicted a crush injury followed by secondary infection. The heel could not touch ground when standing.

Fig 2. Entire resection of the scar tissue results in a 26×18 cm skin defect. The two latissimus dorsi myocutaneous flaps are shown ready for transplantation. The anterior tibial-dorsal pedal artery and the greater saphenous vein of the right leg are shown isolated.

Fig 3. The two lower limbs have been brought together and the vascular anastomosis completed.

Fig 4. Photo taken immediately postoperatively shows the position of the two lower extremities.

Fig 5. Three weeks after transplantation, the flaps have survived with only a small area of superficial necrosis on the anterior-distal aspect.

Fig 6. The affected leg now covered with good quality skin.

Superficial necrosis occurred 10 days later, but the deep tissue survived (Fig 5), this was treated successfully by medium thickness skin graft. The left ankle joint was corrected to a 90 angle with cylindrical PP cast.

Intermittent occlusion of the vascular pedicle within the skin bridge was begun 4 weeks postoperatively and the skin bridge severed after the 8th week. The lower extremities were then separated. The combined free skin flap survived well (Fig 6). The patient was able to walk at the time of writing.

DISCUSSION

Combination of the free skin flaps. Transplantation of a single free latissimus dorsi skin flap is relatively common, but combined bilateral free latissimus dorsi skin flap transplantation has not yet been reported in the literature. One of the essential steps of our procedure is locating the thoracodorsal artery and vein, then freeing in a retrograde manner the circumflex scapular and subscapular vessels. The latter paired vessels can be used to establish a common blood supply or both flaps and a single vascular pedicle to be anastomosed with feeding vessels from the healthy extremity. Anatomically, the subscapular artery usually has a circumflex scapular branch extending about 4 cm distal to its vessel of origin, the axillary artery and about 3-4 cm of this circumflex scapular artery with an average diameter of 2-2.5 mm can be isolated from the surrounding tissue. The subscapular artery, of similar average diameter can also be freed for about 4 cm. The thoracodorsal artery can be isolated distally for more than 4 cm. Therefore the total length of the vascular pedicle may be 8-12 cm. These anatomical features of the subscapular and circumflex scapular arteries and their intrinsic relationship to the blood supply of latissimus dorsi skin flaps render it possible to combine them when necessary for plastic reconstructive surgery. This procedure can be used in repairing extensive skin and deep tissue defects. The left circumflex scapular artery and vein being redundant, were ligated in this patient. They can be utilized very effectively to create a combined triple flap, e.g. when free bone transplantation is also necessary.

Cross-bridge type vascular supply. Not infrequently in extensive skin and deep tissue defects, vessels good enough for anastomosing with those of the transplant vascular pedicle are not available in the recipient region. Adoption of the cross-bridge type of circulatory supply renders these cases amenable to successful plastic repair. Since the vessels of the healthy

limb and free skin flaps are normal, without lesions and have rather large and comparable calibers, the chances of combined flap survival after transplantation is high if the anastomoses are done properly by well-trained microsurgeons. The authors have not encountered a single failure in establishing the cross-bridge type of vascular supply. The total area of free skin flap transplanted in this patient was 578 cm² and the combined flap survived well after severance of the skin bridge. Therefore there is no need to worry about the survival of this type of large free skin flap.

Lumbar pain and deformity of the vertebral column. Although the latissimus dorsi is one of the muscles balancing and stabilizing the vertebral column, unilateral latissimus dorsi skin flap excision has not caused clinically significant ill effects such as spine deformity. Only transient, mild pain was experienced in a few of our cases. The patient reported in this paper, followed up for three months postoperatively, had no functional impairment in raising the upper extremities over the head. No scoliosis developed and there was no pain. The long-term results, however, are not available.

Anesthesia and body position. The patient was an eight-year-old girl and excision and transplantation of the bilateral free latissimus dorsi skin flaps necessitated several shifts in body position and dissection of multiple tissues. Therefore general anesthesia was used. Thorough sterilization and change of surgical gowns were necessary with each postural change, entailing increases in the surgical supplies used. If the entire body surface (except the head, neck, and upper extremities) had been sterilized before induction of general anesthesia, the need for repeating sterilization on each change in position could have been avoided, cutting the operative time significantly.

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PUBLICATIONS

BRIEFS

PHARMACOPEIA OF PEOPLE'S REPUBLIC OF CHINA--On 31 March, the 4th edition was published since 1949. It includes all traditional and Western drugs used in China that have been certified as safe and effective. It also specifies standards for production and distribution. [Excerpt] [Shanghai CHINESE MEDICAL JOURNAL Vol 99, No 5 May 86 p 406] /12858

CSO: 4010/1057

Chemical Engineering

SYNTHESIS OF ETHYLENE-PROPYLENE COPOLYMER WITH SUPPORTED TITANIUM CATALYST

Beijing SHIYOU HUAGONG [PETROCHEMICAL TECHNOLOGY] in Chinese Vol 15, No 4, Apr 86 pp 201-206

[English abstract of article by Zhu Qinqin [2612 0530 0530], et al. of the Department of Chemistry, Zhejiang University]

[Text] A $MgCl_2$ -supported $TiCl_4$ catalyst was prepared through ball milling, which, when combined with iso-Bu₃Al, showed very high activity for the copolymerization of ethylene and propylene under normal pressure, and gave a moderately random copolymer with a crystallinity of less than 2%. The influences of polymerization conditions on the activity and the content of hexane insoluble polymer were investigated. A good relationship was found between the crystallinity of $MgCl_2$ and the content of hexane insoluble product. The analysis of copolymer by DSC, X-ray diffraction and IR, etc. confirmed that the successive propylene and ethylene sequences in the insoluble product were longer than those in soluble random copolymer. The former contains a few polyethylene and polypropylene crystallites. (Paper received 8 October 1985.)

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CSO: 4009/1082

SELECTIVE OLIGOMERIZATION OF ISOBUTENE IN C₄ MIXTURE USING HETEROPOLYACIDS AS CATALYSTS

Beijing SHIYOU HUAGONG [PETROCHEMICAL TECHNOLOGY] in Chinese Vol 15, No 4, Apr 86 pp 207-213

[English abstract of article by Cai Tianxi [5591 1131 6932], et al. of the Chemical Engineering Department, Dalian Institute of Technology]

[Text] The selective oligomerization of iso-butene in C₄ mixture catalyzed by H₃PW₁₂O₄₀, H₄SiW₁₂O₄₀, H₃PMo₁₂O₄₀ and Cr³⁺, La³⁺, Al³⁺, Fe³⁺, Cu²⁺, Cd²⁺, Ca²⁺ and Zn²⁺ salts of H₃PW₁₂O₄₀ has been investigated. It was found that the H₃PW₁₂O₄₀ and its salts, especially the Zn²⁺ salt, showed good activity and selectivity. With a reactant mixture containing about 1% iso-butene and 59% butene-1, reacted at 55-70°C, 1.5-1.6MPa, LHSV 1.5-2.5h⁻¹ over Zn_{3/2}PW₁₂O₄₀, the iso-butene in the product was less than 0.2% and the maximum loss of butene-1 was less than 3%. (Paper received 27 September 1985.)

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CSO: 4009/1082

INFLUENCE OF PHOSPHOROUS ON FORMS OF METALS ON Mo-Ni-P/ γ -Al₂O₃ CATALYSTS,
ACTIVITY OF HYDRODENITROGENATION

Beijing SHIYOU HUAGONG [PETROCHEMICAL TECHNOLOGY] in Chinese Vol 15, No 4,
Apr 86 pp 219-224

[English abstract of article by Wu Zhiren [0702 0037 0088], et al. of the
Process Research Division, Luoyang Design and Research Institute, China
Petrochemical Corporation]

[Text] Relates to the study of the forms of Mo, Ni and P on Mo-Ni-P/ γ -Al₂O₃
catalysts by means of IR and DRS. Results showed the phosphorus on γ -Al₂O₃
was present mainly in the form of aluminum phosphate. The addition of phos-
phorus could influence the forms and distribution of Mo and Ni on γ -Al₂O₃ and
hence the hydrodenitrogenation activity. (Paper received 18 April 1985.)

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CSO: 4009/1082

EFFECTS OF PARTICLE SIZE AND SIZE DISTRIBUTION ON MASS TRANSFER PERFORMANCE IN FLUIDIZED BED

Beijing SHIYOU HUAGONG [PETROCHEMICAL TECHNOLOGY] in Chinese Vol 15, No 4, Apr 86 pp 224-229

[English abstract of article by Wang Zhanguo [3769 2874 5399], et al. of the Department of Chemical Engineering, Zhejiang University, Hangzhou]

[Text] The gas exchange coefficient (K_b) between the bubble and the emulsion phases was measured for three types of particles A,B,C as classified according to Geldart. Particles of active carbon, sand, FCC and Al_2O_3 were used in the experiments. The effects of particle size and size distribution, particle density and velocity difference $u_0 - u_{mf}$, etc. on K_b were also investigated. (Paper received 10 July 1985.)

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CSO: 4009/1087

Chemistry

STUDY ON PHOTOCHEMICAL REACTIONS OF ACID SENSITIVE COLOR-CHANGING MATERIALS

Beijing GANGUANG KEXUE YU GUANGHUAXUE [PHOTOGRAPHIC SCIENCE AND PHOTOCHEMISTRY]
in Chinese No 2, May 86 pp 23-29

[English abstract of article by Wang Yanqiao [3769 5333 0829] et al. of the
Institute of Chemistry, Academia Sinica]

[Text] An acid colour-changing material, composed of halogenated copolymer and acid indicator, has been developed. In order to improve its image quality, the photochemical reaction involved was studied. It was shown that the $\text{VDCl}_2\text{-MA}$ undergoes a simple process of photolysis with the release of HCl , based on the spectral characteristics of $\text{VDCl}_2\text{-MA}$ copolymer before and after exposure to UV irradiation and the ESR and ESCA measurements upon exposure to UV. The experimental results show that upon UV irradiation the transform DMY is converted into cis-form, and the cis-form is unstable and turns back easily into the trans-form when the irradiation is ceased. The rate of the reverse reaction follows first-order kinetics and the rate constant is $1.1 \times 10^{-2} \text{ sec}^{-1}$, measured by flash photolysis. The image recorded by the $\text{VDCl}_2\text{-MA}$ and DMY photographic materials undergoes some fading in storage. By the addition of phenols, the image stability was improved. (Paper received 11 June 1985, finalized 9 September 1985.)

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CSO: 4009/1080

STUDY ON TRIPLE EXCIPLEX

Beijing GANGLANG KEXUE YU GUANGHUAXUE [PHOTOGRAPHIC SCIENCE AND PHOTOCHEMISTRY]
in Chinese No 2, May 86 pp 30-36

[English abstract of article by Chen Shangxian [7115 1424 6343] and Zhang Limin [4545 4539 3046] of the Institute of Chemistry, Academia Sinica]

[Text] It was demonstrated that the interaction of excited acenaphthene with 1,4-dicyanobenzene will lead to the formation of exciplex and triple exciplex. The latter will be formed at higher concentration of acenaphthene. In the case of polyacenaphthylene, intramolecular excimer could be formed between non-adjacent chromophores. As a result of interaction of excited polyacenaphthylene and 1,4-dicyanobenzene, triple exciplex can be formed too. The mechanism of the formation of triple exciplex was proofed as exciplex+triple exciplex but not excimer+triple exciplex. (Paper received 15 August 1985, finalized 7 September 1985.)

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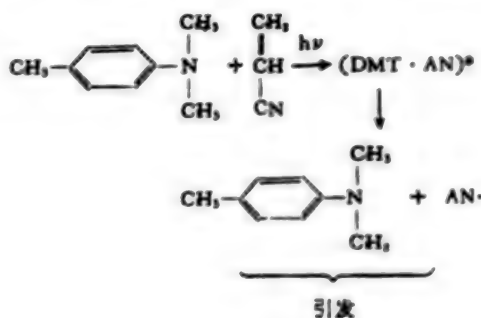
CSO: 4009/1080

STUDIES ON THE MECHANISM OF PHOTOPOLYMERIZATION INITIATED BY AROMATIC AMINES WITH ELECTRON- AND FLUORESCENCE-SPECTROPHOTOMETRIC METHODS

Beijing GANGUANG KEXUE YU GUANGHUAXUE [PHOTOGRAPHIC SCIENCE AND PHOTOCHEMISTRY] in Chinese No 2, May 86 pp 49-55

[English abstract of article by Li Tong [2621 2870], et al. of the Department of Chemistry, Beijing University]

[Text] The end-groups of the polymers formed in photopolymerization initiated by aromatic amines, such as aniline, were identified with electron- and fluorescence-spectrophotometric methods. The spectra show the presence of secondary and tertiary amino end-groups in the polymers formed with primary and secondary amine as initiators, respectively. These results suggest that the nitrogen radicals of the aromatic primary and secondary amines, which were produced from the proton transfer in the exciplexes between amines and vinyl monomers, are also responsible for the initiation (see reaction).



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CSO: 4009/1080

STUDY ON MECHANISM OF LATENT IMAGE FORMATION BY COMPUTER SIMULATION TECHNIQUE

Beijing GANGUANG KEXUE YU GUANGHUAXIE [PHOTOGRAPHIC SCIENCE AND PHOTOCHEMISTRY]
in Chinese No 2, May 86 pp 12-22

[English abstract of article by Zhao Jingquan [6392 0064 3123] and Xia Peijie [1115 1014 2638] of the Institute of Photographic Chemistry, Academia Sinica]

[Text] Monte Carlo computer simulation technique was used for studying the mechanism of latent image formation in cubic crystals of silver bromide. Based on some significant results from the researches on latent image, certain fundamental assumptions were made in this model as follows: 1) before the ionic step starts, the electrons released by photons would rapidly reach an equilibrium between electrons in conductance band and those in shallow traps, where interstitial silver ions could also react besides those in kink sites and dislocation jogs; 2) formations of Ag , Ag_2 , and Ag_3 (nucleation) are inefficient, whereas the growth after the formation of Ag_4^+ is efficient; 3) positive holes produced by photons will have an evolution from holes to Br_2 through V-Centers and bromine atoms, and during the evolution recombination and regression may take place. The estimation of parameters for simulation is based on some physical measurements, such as by microwave technique and dielectric loss, etc. The results from simulation quantitatively show the production and the change of various species, such as reactants, intermediates, and products, and also show a consistency with some macroscopic experimental results, response curves and reciprocity curves. (Paper received 4 May 1985, finalized 15 November 1985.)

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CSO: 4009/1080

SEMANTIC PROCESSOR (SP) BASED ON SEMANTIC PATTERN MATCHING METHOD

Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Vol 9, No 3, 1986 pp 161-168

[English abstract of article by Zhao Ming [6392 2494] of the Institute of Computing Technology, Chinese Academy of Sciences]

[Text] A general purpose semantic pattern matching method for facilitating engineering application is presented. With this method, the semantics of a high level language can be specified by a set of semantic patterns, and the semantic analyses for the parsing trees of source languages can be carried out by finding the semantic patterns matching the trees in semantics. Accurate results were obtained using SP with FORTRAN II compiler on the 757 peripheral machine. (Paper received 28 August 1984.)

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CSO: 4009/1078

DENOTATIONAL SEMANTICS FOR CODE GENERATION LANGUAGES

Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Vol 9, No 3, 1986 pp 169-180

[English abstract of article by Yang Ying [2799 4481] of Wuhan University and Xie Qiguang [6200 1142 0342] of the Wuhan Institute of Digital Engineering]

[Text] A code generator generator's tool (CGGT) is described. Using denotational semantics to specify code generation languages, the Graham-Glanville method for code generation is extended. The emphasis is given to the denotational description of code generation languages. (Paper received 17 January 1984, finalized 22 November 1984.)

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CSO: 4009/1078

APPROACH TO PROCESSING RELATIONAL DATABASES, IMPLEMENTATION ON DDM

Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Vol 9, No 3, 1986 pp 181-189

[English abstract of article by He Xingui [0149 2450 6311] of the Second Research Institute of the Ministry of Space and Astronautics]

[Text] A new approach to processing relational databases based on a particular partition of the databases is presented. It is very suitable to be implemented on a database machine because of the parallelism and the pipelining shown in the approach. Two architectures of data driven database machines, based on VLSI technology, are designed to implement the full parallelism in the approach. Both of them are modular, easy to reconfigure and fault-tolerant. A prototype DDM (Data flow Database Machine) is now under way in the Second Research Institute of the Ministry of Space and Astronautics. (Paper received 30 October 1984.)

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CSO: 4009/1078

Electronics

ANALOG INDUCTOR, LOW-LOSS CAPACITY MULTIPLIER COMPOSED OF COMPLEMENTARY COMPOSITE FOLLOWER

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3, May 86 pp 161-168

[English abstract of article by Zhang Fengxiang [1728 7865 4382] and Shao Qianfen [6730 0241 5358] of the Wuhan Institute of Physics, Academia Sinica]

[Text] A new kind of high Q (quality factor) analogue inductor ($L = 50$ H, $Q = 98.8$) and low-loss (loss resistance R_e may approach zero, i.e. $Q \rightarrow \infty$) capacity multiplier composed of complementary composite follower using field effect and dipolar transistors is proposed.

As compared with the analogue inductor and capacity multiplier composed of integrated operational amplifier, the new device has the following features: its circuit is simple, with only one set of supply, more suitable for low frequency large inductor and capacity multiplier, and has complementary temperature characteristics.

The working principle of this kind of analogue inductor and capacity multiplier is analyzed and the relations between Q and ω , Q and r (complementary resistance), R_e and r are established. The design of this kind of device is also discussed and verified experimentally, and, the expression for the sensitivity of the Q value of the analogue inductor is derived. (Paper received 20 July 1985, finalized 23 November 1985.)

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CSO: 4009/1079

MCA-NEWTON METHOD FOR CIRCUIT YIELD ESTIMATION, OPTIMIZATION

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3, May 86 pp 169-179

[English abstract of article by Yu Xiaoyong [0060 7522 0516] and Zhu Hui [2612 6540] of the Guizhou Polytechnical Institute]

[Text] An algorithm for circuit yield estimation and optimization is described. To obtain the first and second derivatives of yield with respect to center and get the optimal circuit center, the Monte Carlo analysis and Newton method are employed. By using "fail" samples and rearranging sample frequencies according to their weights, two new methods for improving estimation and reducing computation are presented. Both theoretical analysis and calculation examples show that this algorithm performs well and can be used for middle-scale circuit design. No matter the region of acceptability is convex set or not, the algorithm is available. (Paper received 29 August 1984, finalized 18 September 1985.)

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FURTHER RESEARCH ON JACOBI-BESSEL SERIES METHOD IN ANALYSIS OF REFLECTOR ANTENNA

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3, May 86 pp 180-187

[English abstract of article by Li Yi [2496 0500] of the Institute of Spacecraft System Engineering, the Chinese Academy of Space Technology]

[Text] Based on the work on reflector antenna with circularly projected aperture accomplished by R. Mittra and others (1979), this extends the Jacobi-Bessel series method in analysis of reflector antenna to the area where far-field of paraboloid reflector with elliptically projected aperture can be evaluated by using the unique recurrence relations of modified Jacobi polynomials. Meanwhile, a new kind of partial recurrence relations of the series expansion coefficients P_n^m is deduced so that whole CPU time for numerical integration can be saved about three times. (Paper received 29 August 1984, finalized 19 November 1984.)

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INVESTIGATION OF MULTI-ENERGY IMPLANTATION

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3, May 86 pp 204-208

[English abstract of article by Wang Dening [3769 1795 1337] and Wang Weiyuan [3769 3262 3293] of the Shanghai Institute of Metallurgy, Academia Sinica]

[Text] A new calculation method of multi-energy implantation, i.e., "equivalent area method" has been proposed. According to the requirement for designing the specific device, a variety of concentration and implantation energy profile which can be arbitrarily supposed may be obtained by this method. Hence, it is possible to make the thin layer device which has a plane concentration profile.

Using this method, the Si-RAPD device which has a rectangular on low-high-low concentration profile and the GaAs-MESFET or Si-IMPATT device which has a "horse-head" shape concentration profile have been designed and calculated. The calculated results are very satisfying. The prospect of the use of designing new-type device is predicted. The calculated results coincide with the experimental ones given by R.H. Benhard (1977). (Paper received 22 August 1984, finalized 11 June 1985.)

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MONTE CARLO SIMULATION OF ENERGY DISSIPATION PROFILES OF 30, 50, 100 KeV
INCIDENT BEAMS IN LAYERED STRUCTURE IN ELECTRON BEAM LITHOGRAPHY

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3,
May 86 pp 209-216

[English abstract of article by Sun Yuping [1327 3022 1627] of the Institute
of Semiconductors, Academia Sinica, and Liu Hua [0491 5478] of the Chinese
Science Academy of Atomic Energies]

[Text] A Monte Carlo simulation of the energy dissipation profiles of 30, 50
and 100 KeV incident beams in this film (0.4 μ m) electron resist, polymethyl
methacrylate (PMMA), on thick silicon substrate in electron beam lithography
is presented. The radial scattering and energy loss of incident electrons
(including backscattered electrons from the substrate) are simulated under
illumination of ideal point source and Gaussian round beam spot source, and
the histories of 30,000-50,000 electrons are computed. (Paper received
19 September 1984, finalized 5 December 1985.)

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2-D ADAPTIVE Y-C SEPARATOR FOR PAL TV SIGNALS

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3, May 86 pp 228-234

[English abstract of article by Yang Kexin [2799 0344 0207] of the Shaanxi Color Picture Tube Plant]

[Text] A PAL 2-D adaptive separating method with which the characteristics of filters can be controlled by image edge directions at local areas is proposed. The filters and control algorithm for the $4f_{sc}$ sampling system are designed. This method has the advantages of multi-performances, reasonable structure and being able to be easily realized and integrated either by digital circuits or by analogous circuits. Some experimental results are also given.

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MECHANISM OF SECONDARY ELECTRON EMISSION OF Cu-Al-Mg ALLOY

Beijing DIANZI KEXUE XUEKAN [JOURNAL OF ELECTRONICS] in Chinese Vol 8, No 3, May 86 pp 235-240

[English abstract of article by Pan Qihan [3362 1142 3352] of the Beijing General Research Institute of Nonferrous Metals]

[Text] The slices of Cu-Al-Mg alloy with thickness of 0.1 mm are prepared. Some samples are respectively activated at the temperatures of 590°C and 620°C. The secondary emission factors (δ) are determined. The composition of the surface and the electron binding-energy are studied by means of XPS and AES. The oxide layer consisting of Al_2O_3 and MgO can be formed naturally at room temperature is proved. This oxide layer exhibits lower electron binding-energy, high δ and satisfactory stability.

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Metallurgy

THE FRACTURE BEHAVIOR AND STRESS FIELD IN MICRO-ZONE OF (M + F) DUAL PHASE STRUCTURE

Beijing JINSHU RECHULI [HEAT TREATMENT OF METALS] in Chinese No 6, Jun 86
pp 3-9

[English abstract of article by Dong Xiaoyuan [5516 2556 3293], et al.]

[Text] Using the low alloy structure steel 30CrMnSi as the test material, a (M + F) dual phase structure was obtained by intercritical hardening. The properties of strength, toughness and stress corrosion were studied. The influences of morphology and quantity of ferrite on the uniaxial tensile property, K_{IC} and K_{Isc} of (M + F) structure were determined. In order to study the reason for the influence of ferrite and its morphology on the mechanical properties, formulas for the stress field in the micro-zone of (M + F) dual phase structure under stress were derived, and the characteristics of stress and strain were analyzed. The experimental conclusion may be clearly described by the calculations and analytic results.

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TWO SEPARATION PATHS OF BORON PHASE

Beijing JINSHU RECHULI [HEAT TREATMENT OF METALS] in Chinese No 6, Jun 86
pp 10-14

[English abstract of article by Zu Rongxiang [4371 2837 4382]]

[Text] Two separation paths of the boron phase in steel 40MnB were investigated. The boron constituent is precipitated when the steel is heated to higher temperature and slowly cooled or held at lower temperature, this is the first way of precipitation. The steel is cooled quickly from higher temperature and reheated, this is the second way of precipitation. The differences and similarities of the two ways, the amount, size, sites, etc. of the boron constituent precipitated and the main effecting factors are analyzed. The influence of the boron constituent on the properties, as well as the significance of this investigation of the two ways are discussed.

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LOCALIZED HARDENING OF A MACHINE GUN BOLT BY MEANS OF HIGH-INTENSITY SOLAR BEAM

Beijing JINSHU RECHULI [HEAT TREATMENT OF METALS] in Chinese No 6, Jun 86
pp 15-18

[English abstract of article by Zong Quanying [1350 2938 5391], et al.]

[Text] The apparatus and the process for localized transformation hardening of two batches of machine gun bolts by means of a high-intensity solar beam are described. The results show that spots so treated are of good quality and still keeping their original finish and size tolerance. The hardened depth and hardness fulfill the technical requirements. The hardness distribution and microstructure are illustrated and explained. This new localized hardening process is feasible, economical and reliable. This method is very useful for localized hardening of tools, machine parts and even parts of weapons.

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INVESTIGATION EXPANDING APPLICATION OF BORONIZING

Beijing JINSHU RECHULI [HEAT TREATMENT OF METALS] in Chinese No 6, Jun 86
pp 19-22

[English abstract of article by Jiang Zhongshuo [1203 6988 4311], et al.]

[Text] Boronizing, or boronizing with pre-chromizing, carried out at 800-1000°C for steels with different contents of chromium, such as 1Cr13, 1Cr18Ni9Ti, Cr25Al5, Cr26Mo and ferrous base sintered alloy GT-35 were investigated. The hardness of the boronizing layer is about HV3000, and no corrosion is presented on the surface in a moist atmosphere. These advantages are beneficial for further expanding the application and development of the boronizing process.

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STUDY ON BORONIZING IN MEDIUM TEMPERATURE SALT BATH

Beijing JINSHU RECHULI [HEAT TREATMENT OF METALS] in Chinese No 6, Jun 86
pp 26-30

[English abstract of article by Chen Tao [7115 3447] and Chen Binnan [7115 1755 0589]]

[Text] The experimental work of a salt bath with a novel boronizing agent is described. The test of electrolytic and non-electrolytic boronizing with 45, T10, 5CrNiMo, GCrl5 and CrWMn steel showed that, this salt bath has good boronizing effect in the 800-900°C range. The composition of the bath is more stable, the work piece is easily cleaned and there is little corrosive action and no environmental pollution.

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Nuclear Energy

INVESTIGATION OF Si SURFACE DAMAGE INDUCED BY LOW ENERGY ION SPUTTERING

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 7, Jul 86 pp 7-10

[English abstract of article by Zhou Zuyao [0719 4371 1031], et al. of the Shanghai Institute of Metallurgy, Academia Sinica and Shanghai Institute of Nuclear Research, Academia Sinica]

[Text] Silicon crystal lattice damage induced by low energy ions is measured by RBS and channeling. The dependence of the lattice damage on crystal orientation, ion energy and dose is investigated. The kinetics of damage formation is discussed.

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COMPACT SPUTTERING PIG ION SOURCE

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 7, Jul 86 pp 11-14

[English abstract of article by Yu Jinxiang [0060 6855 4382] of Beijing University]

[Text] A compact sputtering PIG ion source with end extraction was described, which can produce both gas and metal ions from cathode materials. The magnetic field is provided by a SmCo permanent magnet. Using Ar and BF_3 as the discharge gas when discharge power was about 30 W, 500-680 μA for Ar^+ , 150 μA for Ar^{2+} and 100-130 μA for B_{11}^+ beam intensities were produced. With argon auxiliary gas, we have got 70 μA for Zr^+ , Fe^+ , Al^+ etc., 50-60 μA for Ta^+ and about 30 μA Ti^+ , Mo^+ metal ions beam intensities. The beam intensity of double charge metal ions were usually 1/2-1/5 of that of single charge metal ions.

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XFT-84 MICROCOMPUTER-BASED X-RAY FLUORESCENT COATING THICKNESS MEASUREMENT
INSTRUMENT

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 7, Jul 86 pp 15-19

[English abstract of article by Lin Jinxin [2651 6855 6854], et al. of the
Shanghai Institute of Nuclear Research, Academia Sinica]

[Text] An intelligent instrument for coating thickness measurement has been developed by using X-ray fluorescent and modern microcomputer techniques. This paper describes the principle and the construction of the instrument. The instrument allows fast, precise and nondestructive measurement of the thickness of various coating plating on metallic or nonmetallic parts. For example, the range of the thickness measurement for magnetic coating layer of the magnetic disc is $M = 50-500\mu\text{g}/\text{cm}^2$, the precision of coating thickness measurement is better than $\pm 4\%$ ($M = 100\mu\text{g}/\text{cm}^2$).

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DETERMINATION OF ABSORBED DOSE OF 14 MeV NEUTRON

Shanghai HE JISHU [NUCLEAR TECHNIQUES] in Chinese No 7, Jul 86 pp 25-29

[English abstract of article by Jiang Lijin [5592 4409 2516], et al. of the Guangdong Institute of Test and Analysis and Chengdu Branch, Chinese Academy of Metrology]

[Text] The paper describes the technique used in measuring absorbed dose components of neutron and photon in the (n, γ) mixed neutron field. The gamma-ray calibration was carried out by a collimated beam of ^{60}Co gamma-ray. The K_T value of a TE-TE ionization chamber was calculated. The K_U values of C-CO₂, Al-Ar chamber and GM counter were measured by a modified lead attenuation method. The correction factors were determined in the neutron field produced by $T(d, n) ^4\text{He}$ reaction. Finally, the neutron Kerma and photon Kerma in tissue free-in-air was measured and their overall uncertainties were estimated.

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